

Exhibit 1

**IN THE UNITED STATES DISTRICT COURT
FOR THE WESTERN DISTRICT OF PENNSYLVANIA**

CARNEGIE MELLON UNIVERSITY,)

Plaintiff,)

vs.)

MARVELL TECHNOLOGY GROUP, LTD.)

et al.,)

Defendants.)

Civil Action No. 09-290
Judge Nora Barry Fischer

OPINION

I. INTRODUCTION

This is a patent infringement case brought by Plaintiff, Carnegie Mellon University (“CMU”), against Defendants Marvell Technology Group, Ltd. and Marvell Semiconductor, Inc. (collectively “Marvell”), alleging that Marvell has infringed two of its patents, U.S. Patent Nos. 6,201,839 (the “‘839 Patent”) and 6,438,180 (the “‘180 Patent”) (collectively, the “CMU Patents”). CMU contends that Marvell’s infringement was willful. (Docket No. 461). Marvell counters that the CMU Patents are invalid. (Docket No. 465). This matter was tried before a jury for four weeks, with jury selection starting on November 26, 2012. (Docket No. 760). A number of motions for Judgment as a Matter of Law (“JMOL”) were made before the verdict was rendered. (Docket Nos. 699; 701; 703; 731; 738; 740; 742; 747). The Court denied these motions on the record¹ on December 21, 2012. (Docket No. 759). The case was then presented to the jury. After deliberations, the jury entered a verdict on December 26, 2012 in favor of CMU on infringement, validity, and willfulness, awarding damages in the amount of \$1,169,140,271.00. (Docket No. 762).

¹ Rather than state its reasons on the record, the parties requested the Court articulate its denial in a written opinion. (Docket No. 764 at 99).

Following the trial, the Court entertained post-trial motions, wherein the parties: (1) renewed their earlier JMOL contentions; (2) moved for a new trial on several grounds; (3) argued the equitable defense of laches; and (4) requested a permanent injunction, post-judgment royalties, supplemental damages, interest, enhanced damages, as well as attorney fees.² (Docket Nos. 786-811). These matters have been completely briefed (Docket Nos. 823-829; 832-837; 849-855; 857-863), and the Court heard argument on same from May 1 through May 2, 2013. (Docket No. 873).³ The Court writes now to explain its reasoning for denying the pre-verdict motions for JMOL, and to rule on the renewed JMOLs, the Motions for New Trial, and Motion for a Remittitur.

II. FACTUAL BACKGROUND⁴

A. *Technology in Suit*

The patents-in-suit are generally directed to the method of sequence detection in high density magnetic recording sequence detectors. *See* ‘839 Patent col.16 ll.20-23.

1. Hard Disk Drive Data Recordings

Hard disk drives (“HDD”) contain a platter or disk that holds data on concentric tracks. (Docket No. 673 at 154). The device bears a visual resemblance to the classic record player. (*Id.*). Just as a record player has a needle attached to the tip of the arm, an HDD has a “read head” that reads and writes data onto these tracks. (*Id.*). Each track is made up of a track width, and this track width is broken into millions of bit regions. (*Id.*). The track is made of magnetic

² The Court has denied CMU’s request for Attorney Fees, without prejudice. (Docket No. 884).

³ The parties had also filed their hearing slides. (Docket Nos. 874; 875). The transcript of these proceedings was then filed on May 15, 2013. (Docket Nos. 880; 881). In August, they provided a joint status report with an update on pertinent technology and financial information as well as a notice of related case authority. (Docket Nos. 889; 891; 893; 896; 897).

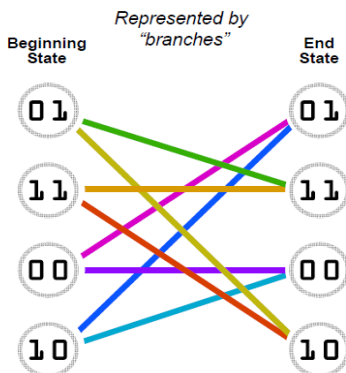
⁴ The Court now sets forth the pertinent facts for a general understanding of the case. Later in this Opinion, the Court will discuss additional evidence as it relates to a particular issue. The Court is mindful that in deciding a motion for judgment as a matter of law, the Court must view the evidence in the light most favorable to the non-moving party. *Galena v. Leone*, 638 F.3d 186, 196 (3d Cir. 2011).

material. (*Id.*). The bit regions are magnetized to store data in the form of “zeros” and “ones.” (*Id.*). As the track moves underneath the read head, the read head picks up the fields emanated from these magnetic regions on the track and turns the fields into read back signal samples. (*Id.* at 155). However, the read back signal samples are not exactly equal to what is actually written on the disk. (*Id.* at 156). For instance, the read back signal may read “0.3” when a “zero” was written on the track. (*Id.*). These discrepancies occurring during the read back process are referred to as “noise.” (*Id.*).

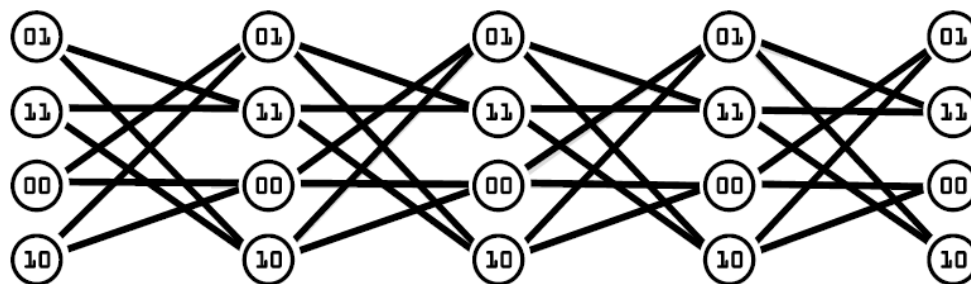
2. Viterbi-Like Detector and the Trellis Concept

A Viterbi-like read channel detector found in the HDD takes the read back signal samples and determines the sequence of symbols written on the disk using a trellis. (*Id.* at 157-158). This process is called “sequence detection.” (*Id.* at 158). A trellis section is used to represent a string of bits sitting on a medium. (*Id.*). There are four potential sequences of two bits, called states: 01, 11, 00, 10; and they can be connected by branches. (*Id.* at 162-163).

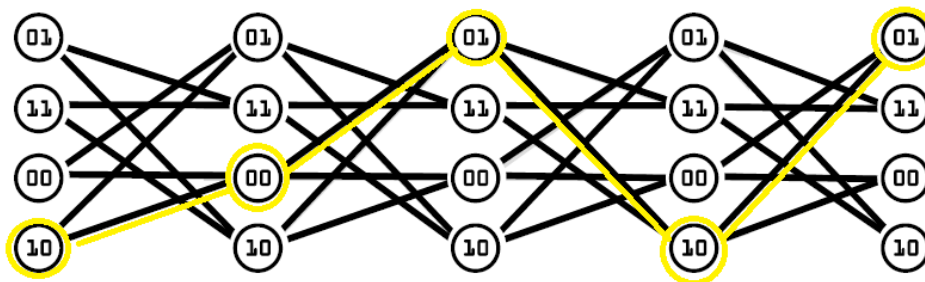
A trellis is used to represent a string of these bits; for example, a three-bit string of 011, would be represented by a “01” connected by a branch to “11.” (*Id.*). One trellis section includes all possible bit sequences. (*Id.*). In this instance, a single trellis section of 011, 010, 111, 110, 001, 000, 101, 100 is represented as follows:



(Docket No. 771 at Ex. C at 14). A trellis can then be created to represent a sequence of any length. For example, a six bit sequence is represented as follows:



(*Id.* at 18). Through this trellis, one can trace a path that is equivalent to a specific sequence of symbols. (*Id.*). For example 100101, is shown below:



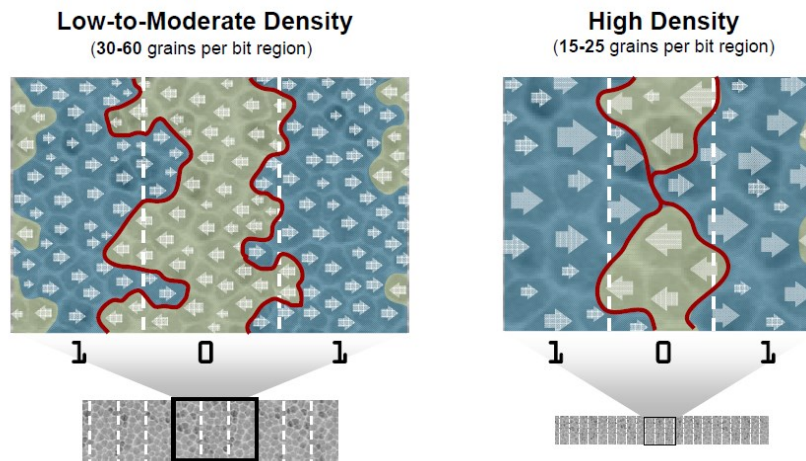
(*Id.* at 17).

The detector determines the “best path” through the trellis, meaning the best or most likely written sequence on the disk, using branch metric values. (Docket No. 673 at 169). The read back signal samples are taken by the detector to compute the branch metric.⁵ (*Id.* at 170). The path with the lowest branch metric values becomes the detected sequence. (*Id.*). Thus, the detector calculates the path with the lowest cumulative branch metric value to determine the detected sequence of zeros and ones written on the disk. (*Id.* at 172).

⁵ One form of computation uses Euclidean branch metrics, which would be $= (r - (\text{the bit value of either zero or one at the point in the trellis}))^2$. (Docket No. 673 at 171). A read back signal of .3 would result in $(.3 - 0)^2 = .09$ or $(.3 - 1)^2 = .49$. (*Id.*). Whichever option gives a value closest to “zero” represents the best guess. In this example, the read back signal most likely represents a “zero” on the drive. (*Id.*). If the “r” value was .9, the branch metric would be $(.9 - 0)^2 = .81$ or $(.9 - 1)^2 = .01$, and the likely signal on the disk is a “one.” As indicated at trial, the magnetic recording disk drive industry no longer uses Euclidean branch metrics. (*Id.*).

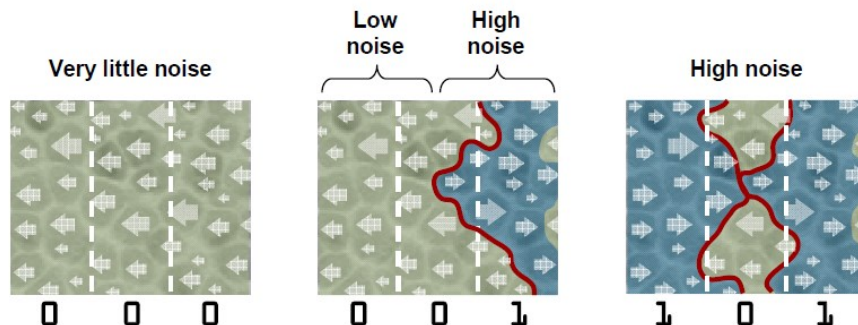
3. Noise

Bit regions are not homogenous. (*Id.* at 175). Rather, they are made up of small tiles or magnetic grains that create regions of magnetization that do not fall within straight bit regions on the track. (*Id.*). As the bit regions become narrower in high density recording and more bits are packed onto a smaller area, there will be fewer grains per bit region. (*Id.* at 176). With fewer grains, islands of grains may develop in which the detector cannot accurately read the data. (*Id.* at 176-177). This is shown below in a diagram in which green represents “zeros,” and blue represents “ones.”⁶



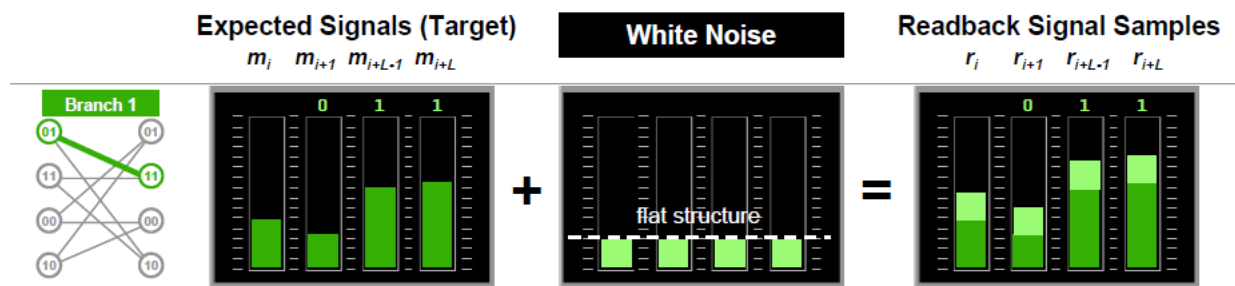
(Docket No. 771 at Ex. C at 24). So, as the density of the recording increases, the amount of noise or uncertainty in the signal also increases. (Docket No. 673 at 179). As seen below, the amount of noise is also affected by the specific sequence of bits written on the track.

⁶ The Court notes that these figures represent how the technology was presented to the jury in teaching this difficult area of technology. Accordingly, they are simplified explanations. The technology tutorial materials contain more in-depth explanations of the technology. *See* (Docket Nos. 108; 109).



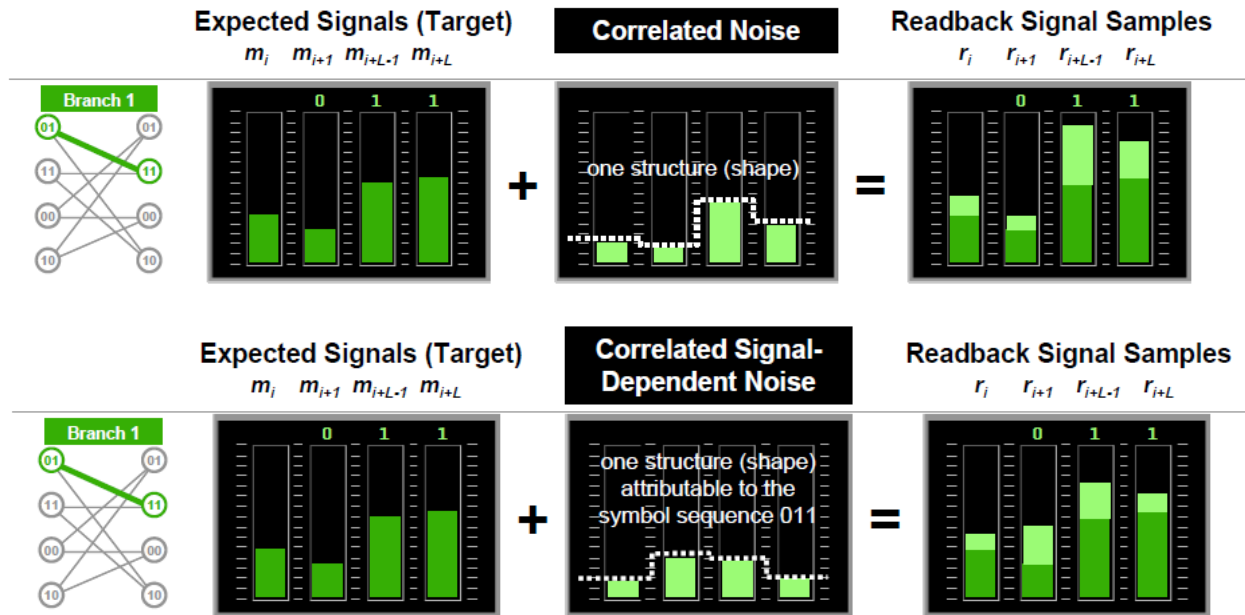
(Docket No. 771 at Ex. C at 25). This is correlated signal-dependent noise, because the noise signals from one boundary to the other move together, either attracting or moving away from each other. (Docket No. 673 at 179).

Noise was previously assumed to be white, or flat, at all time instances and in all branches.⁷ (*Id.* at 183-184). Using this noise assumption in determining disk signals worked in the low density environment of the 1970s and 1980s. (*Id.* at 184). A Viterbi-like detector computed Euclidean branch metric values based on the assumption that the noise was white. (*Id.*). Next, the industry used another assumption, that of correlated noise, where the noise had structure but the structure was the same regardless of the symbol sequence (i.e., written symbols). (*Id.* at 186). The current assumption is that of correlated signal-dependent noise. (*Id.* at 193). This is media noise in the read back signal, whose noise structure is attributable to a specific sequence of symbols. (*Id.*). Below is a comparison of the three forms:



⁷

This is referred to as a white Gaussian noise assumption. (Docket No. 673 at 184).



(Docket No. 771 at Ex. C).

4. The CMU Patents

With the last model of signal-dependent noise, the detected sequence is obtained by maximizing the likelihood function. (Docket No. 673 at 206-207). The CMU Patents start by showing that such a likelihood function is dependent on all the read back signals and all written symbols from the entire disk. (Docket No. 673 at 206-207). This is expressed as:

$$\{\hat{a}_1, \dots, \hat{a}_N\} = \arg \left[\max_{\text{all } a_i} f(r_1, \dots, r_N \mid a_1, \dots, a_N) \right].$$

‘839 Patent Eq. 1.

As there are billions of symbols on the disk, the likelihood function is broken up into smaller per sample functions. (Docket No. 673 at 208). The CMU Patents derived a function based on the observed signal samples; postulated a sequence of written symbols; then applied certain mathematical manipulations to turn the function into a quotient of a likelihood function, as seen below. (*Id.* at 214-215).

$$\begin{aligned} \{\hat{a}_1, \dots, \hat{a}_N\} &= \arg \left[\max_{\text{all } a_i} \prod_{i=1}^N f(r_i | r_{i+1}, \dots, r_{i+L}, a_{i-K_L}, \dots, a_{i+L+K_L}) \right] \\ \{\hat{a}_1, \dots, \hat{a}_N\} &= \arg \left[\max_{\text{all } a_i} \prod_{i=1}^N \frac{f(r_i, r_{i+1}, \dots, r_{i+L} | a_{i-K_L}, \dots, a_{i+L+K_L})}{f(r_{i+1}, \dots, r_{i+L} | a_{i-K_L}, \dots, a_{i+L+K_L})} \right] \\ \{\hat{a}_1, \dots, \hat{a}_N\} &= \arg \left[\min_{\text{all } a_i} \log \prod_{i=1}^N \frac{f(r_{i+1}, \dots, r_{i+L} | a_{i-K_L}, \dots, a_{i+L+K_L})}{f(r_i, r_{i+1}, \dots, r_{i+L} | a_{i-K_L}, \dots, a_{i+L+K_L})} \right] \\ \{\hat{a}_1, \dots, \hat{a}_N\} &= \arg \left[\min_{\text{all } a_i} \sum_{i=1}^N \log \frac{f(r_{i+1}, \dots, r_{i+L} | a_{i-K_L}, \dots, a_{i+L+K_L})}{f(r_i, r_{i+1}, \dots, r_{i+L} | a_{i-K_L}, \dots, a_{i+L+K_L})} \right] \\ \{\hat{a}_1, \dots, \hat{a}_N\} &= \arg \left[\min_{\text{all } a_i} \sum_{i=1}^N M_i(r_i, r_{i+1}, \dots, r_{i+L}, a_{i-K_L}, \dots, a_{i+L+K_L}) \right] \end{aligned}$$

‘839 Patent Eq. 4-6. The resulting function can be used to create different embodiments, as disclosed in the CMU Patents. (Docket No. 673 at 220). One embodiment is called the correlation matrices embodiment, expressed in Equation 13 of the ‘839 Patent:

$$M_i = \log \frac{\det C_i}{\det c_i} + \underline{N}_i^T C_i^{-1} \underline{N}_i - \underline{n}_i^T c_i^{-1} \underline{n}_i$$

‘839 Patent Eq. 13; (Docket No. 673 at 221).

Another form of embodiment is the Finite Impulse Response (“FIR”) embodiment. The FIR filter coefficients operate on a plurality of signal samples and are different for each specific sequence of written symbols. (Docket No. 673 at 225-226). When applied to the FIR embodiment, the coefficients account for the structure of signal dependent noise attributable to that specific sequence. (*Id.* at 227). Once the FIR has been applied to all of the sequences to account for the noise of a specific sequence, a Viterbi-like detector can work on the result. (*Id.* at 228).

As the recording density increases, such detectors become better compared to signal insensitive detectors. (*Id.* at 234). There is little benefit to increasing the amount of data on a disk if it cannot be accurately read. (*Id.* at 90). The patents’ solution constitutes the “optimal”

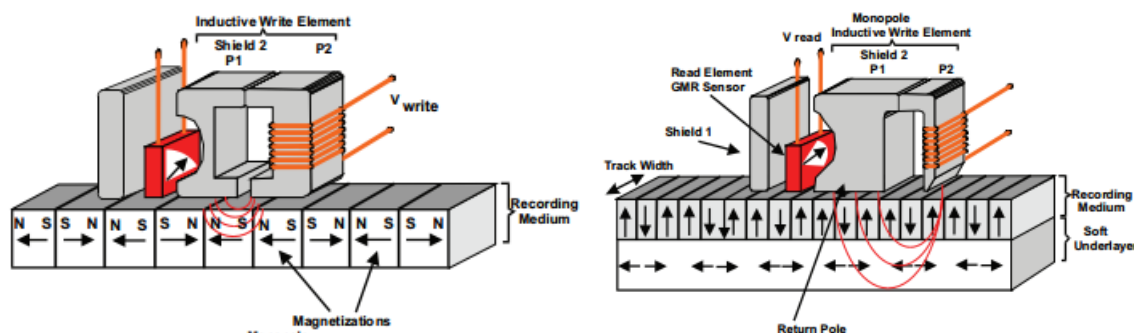
detector, such that when the media noise is the dominant factor there is no better solution. (*Id.* at 70-71; Docket No. 677 at 170).

Media noise became increasingly significant as the industry moved from longitudinal to perpendicular recording around 2005. (Docket No. 678 at 53-53, 114, 226).⁸ Media noise has become the main limiting factor in accurately reading bits from the disk, with 90% of the noise in read channels coming from media noise. (Docket No. 673 at 54). Consequently, academic institutions and private industry undertook research to address this media noise problem at both a theoretical level and product implementation level. (*Id.* at 40-41, 141; Docket No. 707 at 233).

B. CMU/DSSC Background

Carnegie Mellon University is a leading research university located in Pittsburgh, Pennsylvania, with highly ranked engineering, information technology, and computer science programs. (Docket No. 671 at 187). (*Id.*). Dr. Jared Cohon had been the President of the University since 1997.⁹ (*Id.*). In response to the storage industry's decreasing presence in the

⁸ One of CMU's experts, Dr. Bajorek "worked at Komag, between '96 and 2005, [] and led the team that developed the perpendicular magnetic recording disk that became standard in the whole industry." (Docket No. 678 at 553-54). Perpendicular recording is where "the information is stored vertically above the surface of the disk, instead of horizontally. And by storing it vertically, you can pack more bits, you can store more data by having denser data on that disk," but the "the price [] paid in that transition was to also see a dramatic increase in media noise." (*Id.* at 55-56.). Below is picture depicting longitudinal versus perpendicular recording:



See HITACHI GLOBAL STORAGE TECHNOLOGIES, HITACHI RESEARCH AND TECHNOLOGY, available at [http://www.hgst.com/tech/techlib.nsf/techdocs/F47BF010A4D29DFD8625716C005B7F34/\\$file/PMR_white_paper_final.pdf](http://www.hgst.com/tech/techlib.nsf/techdocs/F47BF010A4D29DFD8625716C005B7F34/$file/PMR_white_paper_final.pdf).

⁹ Dr. Cohon stepped down from his position as President on July 1, 2013. His successor is Dr. Subra Suresh, former director of the National Science Foundation. See CMU WELCOMES PRESIDENT ELECT, at <http://www.cmu.edu/homepage/society/2013/winter/cmu-welcomes-president-elect.shtml> (last visited September 20, 2013).

United States, CMU created the Magnetics Technology Center (MTC) in 1983 with the support of industrial funding. (Docket No. 682 at 27). In collaboration with the National Science Foundation, the MTC became the Data Storage Systems Center (“DSSC”) in 1990. (*Id.*). The DSSC is an interdisciplinary center at CMU, funding long-term research and development through federal grants, university investments, and corporate sponsorship. (Docket No. 682). Since 1983, business partners have become “associate members” of the DSSC, by paying a yearly \$250,000 fee, sponsoring faculty chair positions, hiring students and making other investments in the University. (Docket No. 682 at 41-42). DSSC Members at one point or another have included IBM, Seagate, 3M, Hitachi, and Western Digital. (*Id.* at 43-44).

Dr. Mark Kryder¹⁰ testified at trial regarding the history and nature of the DSSC. (*Id.*). Dr. Kryder was the cofounder and director of the DSSC until 1998, when he left to join Seagate where he eventually became the Chief Technology Officer (“CTO”). (*Id.* at 25). Upon retiring from Seagate, he returned to CMU and the DSSC. (*Id.*). According to Dr. Kryder, associate members of the DSSC received disclosures of inventions created in the DSSC and enjoyed a royalty-free license to same. (*Id.* at 43-44). The patents-in-suit were invented within the DSSC. (*Id.* at 43-44). As such, the parties agree that the DSSC members at the relevant time had a royalty-free license to the patents.¹¹ (*Id.*). However, Marvell was never a DSSC Member. (*Id.* at 42).

¹⁰ Dr. Kryder is a professor of electrical and computer engineering at CMU. He has a B.S. in electrical engineering and Ph.D. in electrical engineering and physics from the California Institute of Technology (“Cal Tech”). (Docket No. 682 at 25-26). He taught at the University of Regensburg and worked at the IBM TJ Watson Research Center before joining CMU. (*Id.*). His expertise is in magnetic recording heads and media. (*Id.* at 83). He is knowledgeable about signal processing on a high level, but is not an expert in the field. (*Id.*).

¹¹ The parties debate the relevant time period of the inventions as well as the rights in effect at different points in time. The parties further contest which DSSC companies use (or used) the patents pursuant to their DSSC licenses. (Docket No. 673 at 203-204, 253-257, 268; Docket No. 682 at 161-162, 234-236; 244; Docket No. 726 at 235).

C. Development and Acquisition of CMU Patents

From 1995 to 1998, Professor Jose Moura¹² of the Department of Electrical and Computer Engineering and doctoral student Aleksandar Kavcic¹³ worked to develop a method for addressing problems in high density and media noise problems related to new generation sequence detectors. (Docket No. 673 at 42). On March 10, 1997, they submitted an invention disclosure form to CMU's technology transfer office regarding same. (Pl. Ex. 156). The provisional patent application was filed in May 1997, with the final patent application being filed on April 3, 1998. (Pl. Ex. 1). This patent which was granted on March 13, 2001 is referred to as the '839 Patent. (*Id.*). On March 1, 1999, they filed for a second patent as a continuation in part of the first. (Pl. Ex. 2). It was granted on August 20, 2002, and it is referred to as the '180 Patent. (*Id.*). In 1998 and 2000, the pair published papers: "Correlation-Sensitive Adaptive Sequence Detection" in IEEE Transactions on Magnetics and "The Viterbi Algorithm and Markov Noise Memory" in IEEE Transactions on Information Theory, describing their work. (Pl. Ex. 169, 183).

In 1998, Aleksandar Kavcic received his Ph.D. and left CMU to join the faculty at Harvard University. (Docket No. 673 at 149). He is currently a professor of electrical engineering at the University of Hawaii. (Docket No. 673 at 149). Dr. Moura remains a professor of electrical engineering at CMU. (*Id.* at 37). Pursuant to CMU's policy, half of any proceeds that CMU realizes on these patents, including from this lawsuit, are split between the inventors, Dr. Kavcic and Dr. Moura. (Docket No. 671 at 194-195).

¹² Dr. Moura is originally from Mozambique. (Docket No. 673 at 36). He obtained his undergraduate degree in electrical engineering from the Technical University of Lisbon, Portugal, and his Ph.D. from Massachusetts Institute of Technology ("MIT"). (*Id.* at 36-37). He was a professor at the Technical University of Lisbon and MIT, before becoming a professor at CMU in 1986. (*Id.*).

¹³ Dr. Kavcic is originally from Yugoslavia and obtained a B.S. in electrical engineering from a university in Germany before receiving his Ph.D. in electrical and computer engineering from CMU. (Docket No. 673 at 149-150).

D. CMU's Marketing of the CMU Patents

CMU's Center for Technology Transfer and Enterprise Creation, currently headed by Robert Wooldridge,¹⁴ is tasked with managing the University's intellectual property. (Docket No. 682 at 96). In August 2003, Carl Mahler, Esq.,¹⁵ a subordinate of Robert Wooldridge, sent fourteen letters to several companies, including Marvell, Toshiba, Western Digital, Fujitsu, Samsung, Hitachi, and Maxtor, asking if they would be interested in licensing the '180 and '839 Patents. (Pl. Ex. 422, 431; Def. Exs. 225; 226; 227; 229; 230; 231; 232; 233; 234; 1573). Not all of these companies make read channel or system-on-a-chip ("SOC") products. (Docket No. 682 at 149-153). Two companies contacted CMU declining to license the technology; the rest never responded. (*Id.*).

CMU entered into a subscription agreement with its long-time corporate partner Intel in September 2004. (Def. Ex. 255). For a yearly administration fee of \$75,000, Intel would have the option to license patents from a rotating pool.¹⁶ (Docket No. 682 at 185). If the inventors approved the licensing, Intel could license a patent for a one-time fee of \$200,000. (Def. Ex. 255; Docket No. 682 at 183). In early 2005, it was proposed that the '180 Patent join the pool and in an email regarding same, the inventors also expressed interest in having said patent be part of the

¹⁴ Robert Wooldridge is the Director of the Center for Technology Transfer and Enterprise Creation at CMU since 2001 and has been with the Center for approximately fifteen years. (Docket No. 682 at 96).

¹⁵ Mr. Mahler was not called as a witness for either party.

¹⁶ CMU's relationship with Intel went beyond this subscription agreement. (Docket No. 682 at 97-100). CMU calculated that its partnership with Intel included investment in research, sponsorships, grants, fellowships, and the creation of the Intel Science and Technology Centers on campus. (*Id.*). All of these investments totaled approximately \$150 million of funding for the University. (*Id.*).

pool.¹⁷ (Def. Ex. 263). Regardless of the inventors' recommendation, the Patent was not licensed by Intel. (Docket No. 682 at 100).

E. Marvell and Pertinent Staff

A leading fabless semiconductor company, Marvell was founded in 1995 by Dr. Sehat Sutardja,¹⁸ along with his wife, Weili Dai, and brother, Dr. Pantas Sutardja. (Docket No. 707 at 35). Defendants, Marvell Semiconductor Inc., a California corporation, and Marvell Technology Group, Ltd., a Bermuda corporation, both have their primary place of business in Santa Clara, California. (*Id.* at 29-34). Marvell designs and develops a wide variety of integrated circuit devices, including read channel and SOC devices, used in storage products such as hard disk drives. (*Id.*). Marvell researches, designs, and develops its read channel and SOC products, including the accused products in this case, in Santa Clara. (*Id.*). The company has grown from seven employees to nearly 7,000 employees, and is now a publicly traded company. (*Id.* at 53).

Dr. Sehat Sutardja is the current President and CEO; Ms. Dai is the Vice President and General Manager of Communications and Consumer Business; and Dr. Pantas Sutardja is the Director, Vice President, CTO, and Chief R&D Officer. *See* (Docket No. 707); *see also* MARVELL COMPANY – GLOBAL SEMICONDUCTOR LEADERSHIP, <http://investor.marvell.com/phoenix.zhtml?c=120802&p=irol-govmanage> (last visited September 20, 2013). Together these three individuals own 19% of Marvell. (Docket No. 707 at 146). Dr. Alan Armstrong is the Vice President of Marketing, Storage Business Group and was the company's Rule 30(b)(6)

¹⁷ The email from Dr. Moura to the Intel Program Manager states in relevant part “any reason you did not include in this deal the other patent # 6,201,839 ... the inventors are the same (Kavcic and Moura) and we both would like this included.” (Def. Ex. 263).

¹⁸ Dr. Sutardja is originally from Indonesia. (Docket No. 707 at 36-37). He received his Bachelors in electrical engineering and computer science from Iowa State University, and he obtained his Masters and Ph.D. in electrical engineering and computer science from the University of California, Berkley. (*Id.*). Dr. Sutardja is a member of IEEE, and before starting Marvell, he had worked at Micro Linear and Integrated Information Technology, focusing on chips, digital circuits, and digital signal processors. (*Id.* at 41). He is named the inventor on approximately 300 patents. (*Id.* at 54).

deposition witness regarding same. (Docket No. 707 at 31). Bill Brennan is the former Vice President of Sales, Storage Business Group. (Docket No. 707 at 31). Mr. Michael O'Dell is the worldwide director of field application engineering at Marvell and worked for Mr. Brennan in the early 2000s. (Docket No. 726 at 233).

Relevant engineering employees include Dr. Zining Wu, Gregory Burd, and Toai Doan. Dr. Wu joined Marvell in 1999 after receiving his Ph.D. in Electrical Engineering from Stanford University. (Docket No. 707 at 217-219). Mr. Burd¹⁹ joined Marvell in the same year. (Docket No. 726 at 129). Mr. Doan, was a manager and principal engineer of signal processing and later Vice President of read channel development. (Docket No. 761 at Jt. Ex. D-1 at 1). Mr. Doan left Marvell in October 2009. (*Id.*). Last, Dr. Nersi Nazari was Mr. Burd's acting manager in the early 2000s.²⁰ (Pl. Exs. 280; 283; 285). Of note, he was also Dr. Kavcic's contact within Marvell. (Def. Ex. 1023). In fact, Dr. Kavcic emailed him in early March 1998, inquiring about Marvell's work on detectors, sending him a link to his recent publications, resume and work, and seeking information on job openings at Marvell. (Def. Ex. 1023).²¹

¹⁹ Mr. Burd is originally from Moscow, Russia, and came to the U.S. at age 18. (Docket No. 726 at 125-130). He obtained a B.S. in mathematics and statistics from the University of Wisconsin, a Masters in mathematics from Oregon State University, and completed some Ph.D. work at the University of Washington before joining Marvell in 1999. (*Id.*).

²⁰ Dr. Nazari was not deposed and he did not appear at trial. Interestingly, he now works at a health care company called Vital Connect, with Mr. Doan and Mr. Brennan. *See* EXECUTIVE TEAM, VITAL CONNECT <http://www.vitalconnect.com/executive-team> (last visited September 20, 2013).

²¹ The email reads:

Hi Nersi, Somebody told me last week at our annual DSSC review here at Carnegie Mellon that Marvell has a detector that implements some of the approaches I suggested in my talk here. It is also in GLOBECOM 98 paper I sent you. Is there a write-up regarding this detector. Also I am going to graduate soon (May) and am on the look for jobs. [*sic*] Is Marvell hiring by any chance. Please let me know. My resume and downloadable publications are on my web page. The URL is Thanks, Alex.

(Def. Ex. 1023). The URL is no longer active. (last visited September 20, 2013). This Globecom Paper addresses some of the ideas expressed in the patents, but it is not the IEEE paper later referenced by Burd. (Docket No. 674 at

F. Marvell's Development of Read Channel Products

Both Dr. Wu and Mr. Burd worked to develop new technologies for digital signal processing and read channel technologies. (Docket No. 707 at 221). As discussed, a read channel is situated between a drive's controller and the analog recording head, providing an interface so that digital data can be read from the disk. (*Id.* at 30). As data is packed more tightly onto the disk, errors arise from adjacent data tracks. (*Id.* at 96). The extent to which the error can be corrected limits how much data can be stored on the disk. (Docket No. 707 at 231). Hence, the team at Marvell worked to increase the signal-to-noise ratio ("SNR") in its read channel chips, addressing media noise and other sources of noise, such as asymmetric noise, baseline wander, and thermal noise. (*Id.* at 230-234). One of their earlier projects from around 1999 to 2001 was implementing iterative coding, a different method of improving SNR on chips. (Docket No. 678 at 119). This form of coding was also the basis of Dr. Wu's Ph.D. thesis at Stanford. (Docket No. 707 at 255). However, iterative coding was not initially successful for Marvell.²² (Docket No. 687 at 119-124). In fact, Mr. Doan called these chips a "lost cause" and Mr. Brennan said many referred to them as "coffee warmer" chips because they used so much power. (*Id.*).

G. MNP/NLD Chip Development

Because iterative coding was not initially successful, the team at Marvell continued to work on other potential solutions to the noise problem. (Docket No. 687 at 119-124). In 2001,

118). In this Court's estimation, it could be inferred that Dr. Nazari gave Dr. Kavcic's work to the Marvell team working in this arena. *Caver v. City of Trenton*, 420 F.3d 243, 262 (3d Cir. 2005) (a Court must view all reasonable inferences in light most favorable to non-moving party when determining the facts on JMOL). The response to this email was not proffered at trial and as such the Court cannot consider the response in deciding the present motion. *See Goodman v. Pennsylvania Tpk. Comm'n*, 293 F.3d 655, 665 (3d Cir. 2002) (on Rule 50 motions the court can only consider properly admitted evidence). Yet, in the hearing on post-trial motions, Marvell presented Dr. Nazari's response, which stated in relevant part that "as far as I know our [*sic*] we do not have a product in line of your work, yet. Yes, we are hiring and I'll read your resume on the web..." (Def. Ex. 1611).

²² Marvell was not able to install iterative coding on chips until the 2007-2008 time period. (Docket No. 707 at 105-106).

Mr. Burd read the papers by Dr. Kavcic and Dr. Moura explaining their invented method and he began working on developing a “solution” for Marvell based on same. (Docket No. 726 at 137). CMU asserts that Marvell “copied” Dr. Kavcic’s method as described in said articles and claimed in the ‘180 and ‘839 Patents. (Docket No. 677 at 54-55). In response, Marvell maintained throughout trial that Mr. Burd had developed his own sub-optimal “solution,” using Dr. Kavcic’s scheme only as a launching pad, as later expressed in Marvell’s U.S. Patent Number 6,931,585, which listed the ‘180 Patent as prior art. (Docket No. 726 at 125-135). The method Mr. Burd developed, originally named KavcicPP, was renamed “MNP” in January 2003 and later incorporated into Marvell’s EMNP and NLD technology, all of which are used on read channel chips and SOC chips (collectively, the “Accused Chips”). (Pl. Exs. 368; 823). In connection with same, simulators were developed by Marvell engineers to mimic chips, so that Marvell engineers could run and test the chip systems before producing the chips in silicon. (Docket No. 707 at 113-114). Marvell also ran all of its chips against what it considered the optimal benchmark simulator, called KavcicViterbi. (Docket No. 677 at 171-172; Docket No. 761 at Jt. Ex. D at 137-138). The KavcicPP, MNP, EMNP, and NLD type simulators and the KavcicViterbi simulator are collectively the “Accused Simulators” in this litigation. (Pl. Exs. 89; 99; 106; 108; 110). The Accused Chips and Accused Simulators are collectively referred to as the “Accused Technology.”

H. Marvell’s Sales of Accused Chips

Read channel chips were dominant until around 2004, when the industry transitioned to SOC-type chips. (Docket No. 707 at 309-311). SOC chips integrated several different blocks,²³

²³ Other blocks on SOC chips include the central processing unit, the hard drive controller, a servo block controlling the mechanics in the HDD, and the chip level circuit, among others. (Docket No. 707 at 224).

including the read channel block, onto one chip to improve speed, power, and cost. (*Id.* at 226). Today, Marvell has about 800 employees involved in the development of SOC chips. (*Id.*).

CMU alleged infringement by Marvell's MNP, EMNP-type and NLD type chips, encompassing both read channel and SOC chips. (Docket No. 671). All of the Accused Chips were custom made to the exact specifications requested by the customer. (Docket No. 678 at 50-142). As noted, the custom designs and sample engineering chips are developed and tested by using them with the Accused Simulators. Sample engineering chips are produced in Asia and sent back to the United States to be tested by both Marvell and its customers. (Docket No. 678 at 105-106; Docket No. 707 at 164). Once the customer places an order, the chips are put into production at Taiwan Semiconductor Manufacturing Company's ("TSMC") foundry in Taiwan.²⁴ (Docket No. 707 at 164). Marvell field application engineers then assist the hard drive company to install chips into their product and instruct them on how to use the chips. (Docket No. 677 at 178-179).

As stipulated by the parties, Marvell sells its chips through a lengthy sales cycle, in which Marvell must invest significantly in each customer without the assurance of sales. (Docket No. 707 at 32-35). There is first a 3-6 month period of rigorous evaluation and reliability testing by the customer in a stage called "qualification." (*Id.*). This is followed by a 12-18 month development period and then a 3-6 month period before Marvell commences volume production (i.e. until 1 million units are produced). (*Id.*). Throughout this entire cycle, there is a significant risk the customer will change its mind before the design is selected and the time and expense incurred by Marvell will generate no revenue. (*Id.*). Since a customer usually uses a selected

²⁴ A "foundry" is a business that operates a semiconductor fabrication plant (commonly called a "fab") for the purpose of fabricating the designs of other companies. PCMAG ENCYCLOPEDIA, <http://www.pcmag.com/encyclopedia/term/43433/foundry> (last visited September 20, 2013).

design for a full generation, the loss of a sales win cannot be remedied until the customer develops a new product or new generation. (*Id.*).

During this sales cycle, Marvell engineers assist the customer in implementing the Marvell solutions into its product. (*Id.*). Almost all of this activity, including sales,²⁵ marketing, evaluation, testing, and development occurs in Santa Clara, California. (*Id.*). The Accused Simulators are used at various points throughout this sales cycle to formulate product concepts and to design, refine and evaluate chip designs. (*Id.* at 45). As CMU's expert witness Dr. Steven McLaughlin testified, the simulators are used for research and development to verify the hardware design for the chip. (Docket No. 677 at 158). Marvell provides the simulation code to its customers so they can evaluate the functionality and performance of a chip design. (*Id.*). Marvell's major customers are Fujitsu, Hitachi/IBM, Maxtor,²⁶ Samsung, Seagate, Toshiba, and Western Digital.²⁷ (Docket No. 710 at 243-244). All of these customers go through this process with Marvell at its Santa Clara location. Once the customer is satisfied that the design and testing have met its specifications, the chip designs and engineering samples are sent back to TSMC to begin volume production. (Docket No. 678 at 92).

According to Marvell sales data, between March 6, 2003 and July 28, 2012, Marvell sold 2.34 billion Accused Chips. (Docket No. 686 at 61). The average revenue per accused chip is \$4.42, with an average operating profit of \$2.16. (*Id.* at 53-54). As noted, the chips are manufactured by TSMC foundry in Taiwan, and then sent to the customers' manufacturing sites in Asia to be put into their HDDs. (Docket No. 710 at 360-361). These HDDs are then sold

²⁵ Until his departure from Marvell, Vice President of Sales Mr. Brennan signed off on all deals. (Docket No. 761 at Jt. Ex. C at 7).

²⁶ Maxtor was bought by Seagate in 2006. (Docket No. 673 at 268).

²⁷ Teik Ee Yeo and Iftiqar Baqai testified at trial on behalf of Western Digital. (Docket No. 671 at Jt. Ex. B; Docket No. 711).

primarily to laptop manufacturers, which incorporate the HDDs into their products at their own factories. (*Id.*). A portion of the laptops are then imported back into the United States. (*Id.* at 164-165). The locations of the chips' end users are unknown, but CMU presented estimates based on import data calculated by its damages expert that 329,297,799 or 556,812,092 of the 2.34 billion Accused Chips were imported in to the United States. (*Id.* at 165; Docket No. 770-11 at 7).

I. Correspondence Regarding CMU Patents

In January 2002, Mr. Burd sent two emails to Mr. Doan, who was then his boss at Marvell, stating that the Kavcic method was patented and assigned to CMU.²⁸ (Pl. Exs. 280; 283). The following year, Carl Mahler of the CMU Technology Transfer Office sent out fourteen letters to various technology companies, including two addressed to Marvell personnel Dr. Pantas Sutardja and then-General Counsel Matthew Gloss, encouraging these companies to contact CMU if they were interested in licensing the '180 and the '839 Patents. (Pl. Exs. 422; 431). There was no known response by Marvell to these letters from Mr. Mahler. In 2004, Fujitsu, a read channel customer, wrote a letter to Marvell, stating that it had become aware of the '839 Patent and asked for Marvell's position regarding the relationship between these patents and its own technology. (Pl. Ex. 477). There is no known response to this letter. (Docket No. 761 at Ex. C at 531-535).

J. Parties' Evidence as to Infringement

At trial, CMU maintained that Marvell makes, uses, offers to sell, or sells chips and uses simulators that infringe Claim 4 of the '839 Patent and Claim 2 of the '180 Patent.

Claim 4 of the '839 Patent provides:

²⁸ These facts are admitted by both parties and supported by the evidence presented at trial, but the motivations and effect of these points were greatly debated.

[a] method of determining branch metric values for branches of a trellis for a Viterbi-like detector, comprising:
 selecting a branch metric function for each of the branches at a certain time index from a set of signal-dependent branch metric functions; and
 applying each of said selected functions to a plurality of signal samples to determine the metric value corresponding to the branch for which the applied branch metric was selected wherein each sample corresponds to a different sampling time instant.

‘839 Patent col.14 ll.10-19.

Claim 2 of the ‘180 Patent, incorporates Claim 1. Claims 1 and 2 of the ‘180 Patent state:

1. A method of determining branch metric values in a detector, comprising:
 receiving a plurality of time variant signal samples, the signal samples having one of signal-dependent noise, correlated noise, and both signal dependent and correlated noise associated therewith;
 selecting a branch metric function at a certain time index;
 and
 applying the selected function to the signal samples to determine the metric values.
2. The method claim 1, wherein the branch metric function is selected from a set of signal-dependent branch metric functions.

‘180 Patent col.15 ll.39-51.

CMU argued that Marvell’s MNP and NLD Chips infringed these claims. CMU also asserted that Marvell’s KavcicPP Simulator, MNP Simulator, EMNP Simulator (these three collectively the MNP-Type Simulators), NLD Simulator, and KavcicViterbi Simulator infringed Claim 4 of the ‘839 Patent and Claim 2 of the ‘180 Patent.

Counsel for the parties prepared a stipulation on the chip technology, affectionately called the “Chip Stip.” (Pl. Ex. 823). The parties agreed that the circuits set forth therein are true and accurate depiction of the circuits within Marvell’s products. (*Id.*) The stipulation identified

which Marvell read channel and SOC models correspond to each of the stipulated circuits.²⁹ (*Id.*) CMU submitted the stipulation as evidence of infringement to the jury. (Pl. Ex. 823). Marvell's code for the KavcicPP Simulator (Pl. Ex. 110), MNP Simulator (Pl. Ex. 99), EMNP Simulator (Pl. Ex. 89) (these three collectively, the "MNP-Type Simulators"), NLD Simulator (Pl. Ex. 106), and KavcicViterbi Simulator (Pl. Ex. 108) was also admitted as evidence of infringement.

Further, the parties presented competing expert opinions on infringement. For CMU, Dr. Steven McLaughlin³⁰ opined that Marvell's chips and simulators infringed CMU's patents. (Docket No. 677). Dr. McLaughlin testified over two days using a PowerPoint presentation with over 130 slides to help demonstrate his infringement analysis.³¹ (Docket No. 677-678). In doing so, Dr. McLaughlin analyzed the Chip Stip, Simulator Code, Marvell's technical documents, and relevant deposition testimony from Marvell's engineers in reaching his conclusions. At trial, he broke down both claims into elements and demonstrated to the jury how the circuitry of the MNP Chips and NLD Chips, in addition to the code of the Accused Simulators, infringed each and every step of the two patents. (Docket No. 771). He was clear that as these are method claims, infringement only occurs when the method is actually run on the chips or simulators. (*Id.*).

²⁹ There are approximately 206 accused Models of chips. *See* (Pl. Ex. 1912; P-Demo at 39; Docket No. 771 at Ex. 19 at 6).

³⁰ Dr. McLaughlin has a Ph.D. in electrical engineering and is currently the chair of the School of Electrical and Computer Engineering at the Georgia Institute of Technology. (Docket No. 677 at 30-31). Dr. McLaughlin's ability to testify as an expert based on his knowledge, skill, experience, training, and education was not challenged by Marvell. (Docket No. 677 at 36). Given the small community focused on this technology, Dr. McLaughlin knows, professionally, Dr. Kavcic, Marvell's Dr. Wu, and both of Marvell's experts Dr. Blahut and Dr. Proakis. (*Id.* at 34). He was previously retained as a Technical Expert by Judge Posner in *Apple v. Motorola*. Civ. No. 11-8540 (N.D. IL). (Docket No. 677 at 35). His experience in this field of art spans from basic research, writing papers, and teaching, to implementation on chips in a commercial setting. (Docket No. 456 at 1). Dr. McLaughlin provided an expert report on his infringement opinions in accord with Rule 26(a) and a deposition on same. *See* (Docket No. 456). The Court accepted him as an expert in signal processing. (Docket No. 677 at 36).

³¹ The Court acknowledges that the transcript may not always be clear on what parts of a diagram are being described by witnesses, as much testimony included pointing out with a laser pointer certain spots on circuit diagrams that corresponded with elements of the claim. To aid in this endeavor, the Court required the parties to file all demonstratives used during the trial. Dr. McLaughlin's presentation is P-Demo 7. (Docket No. 771 at Ex. H).

Marvell countered with Dr. Richard Blahut,³² who opined that there was no infringement of the CMU Patents. (Docket No. 711). Dr. Blahut believes that in the Marvell products, the Viterbi algorithm uses a simple branch metric function that uses the same branch metric function on every branch of the trellis, so there is no selecting step as required in the patents. (*Id.* at 244). He also opined that there was no selecting function in the Viterbi detector or post processor; hence, there was no applying step as required by the CMU Patents. (*Id.* at 246).

K. Parties' Evidence as to Invalidity

During trial, Marvell maintained that CMU's Patents were invalid because they were both anticipated³³ and obvious.³⁴ To this end, Marvell submitted U.S. Patent No. 6,282,251 (the "Worstell Patent") as prior art for purposes of its anticipation defense. (Def. Ex. 187). This patent was filed on March 21, 1995, three years before the CMU Patents were filed. (*Id.*). As further evidence of invalidity, Marvell also presented a 1992 IEEE article by Inkyu Lee and John Cioffi titled "Performance Analysis of the Modified Maximum Likelihood Sequence Detector in the Presence of Data-dependent Noise" and a 1992 IEEE Transactions on Magnetics article by Weining Zeng and Jaekyun Moon titled "Modified Viterbi Algorithm for a Jitter-dominant 1-D2 Channel" (Def. Exs. 37; 38).

³² Dr. Blahut is a professor of electrical and computer engineering at the University of Illinois and has received many awards throughout his career. (Docket No. 771 at 207). He has experience with signal processing and read channels, both as an academic and during his time at IBM. (*Id.* at 207-216). Dr. Blahut's opinions went through a *Daubert* challenge prior to trial, after which the Court accepted him as an expert in signal processing and read channel technology. (Docket No. 447).

³³ A patent claim is "invalid for anticipation if a single prior art reference discloses each and every limitation" of the claim. *Schering Corp. v. Geneva Pharm.*, 339 F.3d 1373, 1377 (Fed. Cir. 2003) (emphasis added).

³⁴ An obviousness analysis measures the difference between the claimed invention and the prior art to determine whether "the subject matter as a whole would have been obvious at the time the invention was made" to a person having ordinary skill in the art. *Alza Corp. v. Mylan Labs., Inc.*, 464 F.3d 1286, 1289 (Fed. Cir. 2006) (citations omitted).

Again, the parties had dueling expert witnesses appear. Dr. John Proakis³⁵ testified for Marvell, and opined that the CMU Patents were invalid based on the aforementioned prior art. (Docket No. 726). CMU called Dr. McLaughlin in rebuttal to testify on the subject of invalidity. (Docket No. 736). Dr. McLaughlin countered Dr. Proakis' testimony and concluded that the CMU Patents were not invalid based upon the two IEEE articles and/or the Worstell Patent. (*Id.* at 73). CMU also submitted a critical 1997 email from Glen Worstell, stating in relevant part that he:

had reviewed the 'Correlation Sensitive Adaptive Sequence Detector' patent proposal (i.e. the proposal of the CMU Patents) ... A couple of years ago I did some work on a Viterbi detector modification to account for noise correlation. This invention is related, but goes beyond my work and is probably more interesting.

(Pl. Ex. 161).

L. Damages Evidence

CMU sought money damages from Marvell for infringement, in the form of a \$0.50 per chip royalty on all Accused Chips sold by Marvell from March 2003 to the present. CMU proffered evidence that the Accused Technology was "must have" for Marvell and thus the parties would have agreed to this running royalty at a hypothetical negotiation in March 2003.³⁶ In support of its position, CMU first called Dr. Christopher Bajorek³⁷ as an industry expert.

³⁵ Dr. Proakis is an adjunct professor of U.C. San Diego, and former professor and Chairman of the Department of Electrical and Computer Engineering at Northeastern University. (Docket No. 726 at 53). He has written several textbooks on electrical engineering and signal processing, and consulted for Quantum Corporation and Digital Equipment Corporation designing read channel systems. (*Id.*) The Court accepted him as an expert in digital signal processing and read channel technologies. (*Id.* at 54). CMU did not make any *Daubert* challenges to Dr. Proakis's opinion.

³⁶ The parties agreed that the hypothetical negotiation would have occurred on March 6, 2003. (Docket No. 686 at 60).

³⁷ Dr. Bajorek obtained his Ph.D. in electrical engineering from Cal Tech. (Docket No. 678 at 51). He has worked in the HDD industry for 40 years, including at IBM where he worked to commercialize the first Viterbi channel and at Komag as CTO and Vice President. (*Id.* at 52-53). The Court accepted Dr. Bajorek as an expert

(Docket No. 678 at 72-73). Dr. Bajorek opined that Marvell and its customers used the MNP and NLD technologies during the sales cycle; the sales cycle essentially took place in the US; that the MNP and NLD technology had become industry standard;³⁸ and that the same technology was “must have” for Marvell. (*Id.*). Dr. Bajorek testified that Seagate, IBM, HDST, Samsung, Western Digital, and Toshiba use or previously used the patented technology. (*Id.* at 163-165). Marvell did not counter Dr. Bajorek with a competing expert in his area of expertise.

CMU next called Catherine Lawton³⁹ as its damages expert. (Docket No. 686 at 29). She stated that Marvell sales data showed sales of 2.34 billion Accused Chips between March 6, 2003 and July 28, 2012. (Docket No. 686 at 61). She then analyzed sales data provided by Marvell to calculate an “excess profits” benchmark of \$0.42 per chip and “operating profit premium” benchmark of \$0.06 to \$0.72 per chip, which she used along with other pertinent facts to arrive at a reasonable royalty of \$0.50 per chip. (Docket No. 710 at 170-171). Her analysis is examined in more detail later herein.⁴⁰

CMU also submitted supporting evidence in the form of internal Marvell communications and presentations, including Marvell presentations to customers, deposition testimony from Marvell sales and marketing executives such as Mr. Brennan and Dr. Armstrong,

witness in the areas of the hard disk drive industry, industry standards, and the use of Marvell’s technology as elucidated in his report. (*Id.* at 63). Marvell filed a *Daubert* challenge to Dr. Bajorek which the Court granted, in part, and denied, in part. (Docket No. 445).

³⁸ A technology becomes “industry standard” when it is adopted by the majority of drive makers for two or more generations of drives. (Docket No. 678 at 108-109).

³⁹ Ms. Lawton is a damages consultant with Berkeley Research Group. She has a degree in finance and has been working in the field of damages calculation for 27 years, testifying and working on a variety of cases. Marvell filed a *Daubert* challenge to Ms. Lawton which the Court granted, in part, and denied, in part. (Docket No. 451). After a full day of examination on her credentials and experience both before the jury and *in camera*, she was accepted by the Court as an expert in IP damages. (Docket No. 713).

⁴⁰ See discussion *infra* at Section V.D.4.

as well as the joint stipulation regarding Marvell's sales cycle. (Pl. Exs. 220; 240; 244; 297; 331; 333; 651; 938).

Marvell rebutted this damages calculation by presenting its own damages expert, Creighton Hoffman.⁴¹ (Docket Nos. 709; 710). Mr. Hoffman based his opinion primarily on the DSSC Agreements (Def. Exs. 17; 39; 40), the Intel offer to license (Def. Ex. 255), and his perception of a lack of marketing and licensing of the patents by CMU or their Inventors.⁴² (Docket No. 709). His ultimate opinion was that a reasonable royalty in this case would be a one-time royalty payment of \$250,000.00. (*Id.* at 242-245). Marvell did not submit any evidence on other licensing agreements or alternative pricing opinions.

M. Evidence of Alleged Willfulness

CMU argued that Marvell's infringement had been willful by submitting evidence of Marvell's internal communication about the patents, including the aforementioned emails from Mr. Burd (Pl. Ex. 280, 283), the letters received from CMU (Pl. Exs. 422; 431), the letter from Fujitsu (Pl. Ex. 477), and deposition testimony of Dr. Wu, Mr. Doan, Dr. Armstrong, and Mr. Burd. *See* (Docket No. 677 at 53-55; Docket No. 761 at Jt. Ex. C, D). CMU also submitted Dr. McLaughlin's expert testimony to the extent that he opined that the MNP was "copied" from the CMU Patents. (Docket No. 677 at 82).

Marvell presented evidence to show that it had not willfully infringed, relying on internal Marvell correspondence and presentations on the Accused Technologies and proof of Marvell's own patents, some of which cite the CMU Patents. (Def. Ex. 266). Marvell also offered portions

⁴¹ Mr. Hoffman is a CPA previously employed at Price Waterhouse, now with Hoffman-Alvary, where he primarily deals with intellectual property negotiations and damages consulting. (Docket No. 709 at 105-172). CMU filed a *Daubert* challenge to Mr. Hoffman which the Court granted, in part, and denied, in part. (Docket No. 450). The Court accepted him as a damages expert in the realm of intellectual property damages. (*Id.* at 172).

⁴² *See* discussion *supra* at Section II.D "CMU's Marketing of the CMU Patents," and the August 5, 2003 CMU letters to which Wooldridge testified that no company expressed any interest in taking a license. (Pl. Exs. 422; 431; Def. Exs. 225; 235; 1573).

of Dr. McLaughlin's deposition testimony to disprove copying from Dr. Kavcic and Dr. Moura, as well as testimony at trial, such as that of Mr. Burd, (Docket No. 726 at 125-126), and Dr. Wu, (Docket No. 707 at 326), who stated they did not copy the CMU Patents. As Dr. Sehat Sutardja testified, Marvell's people "are not stealers." (Docket No. 707 at 92, 326).

N. Jury Verdict

On December 21, 2012 the jury was charged to decide issues of infringement, validity, damages, and willfulness given all of the evidence before it. The jury deliberated for nearly two days to render its verdict, returning on December 26, 2012. (Docket No. 762).

With respect to infringement, the jury found that CMU had proven by a preponderance of the evidence that Marvell's MNP-Type chips, MNP-Type simulators, NLD-Type chips, NLD-Type simulators, and Kavcic-Viterbi simulator literally infringe Claim 4 of the '839 Patent and Claim 2 of the '180 Patent. (*Id.* at Q. 1-10). The jury held that CMU had proven by a preponderance of the evidence that Marvell had induced at least one of its customers or an end user to infringe Claim 4 of the '839 and Claim 2 of the '180 Patent in the United States with both the MNP-Type and NLD-Type Chips. (*Id.* at Q. 11, 13). It additionally found that CMU had proven by a preponderance of the evidence that Marvell contributed to the infringement of Claim 4 of the '839 and Claim 2 of the '180 Patent in the United States by at least one of its customers or an end user with both the MNP-Type and NLD-Type Chips. (*Id.* at Q. 12, 14).

On invalidity, the jury found that Marvell had not proven by clear and convincing evidence that Claim 4 of the '839 and Claim 2 of the '180 were invalid on the grounds that they were anticipated by prior art or because they would have been obvious at the time the invention was made. (*Id.* at Q. 15, 16). After finding that the claims infringed and are not invalid, the jury awarded \$1,169,140,271.00 to CMU for the use of the patented methods. (*Id.* at Q. 17).

Regarding willfulness, the jury found that Marvell had actual knowledge of the ‘180 and ‘839 Patents prior to commencement of the lawsuit on March 6, 2009. (*Id.* at Q. 19, 22). It determined that Marvell did not have an objectively reasonable defense to CMU’s claim of infringement on either the ‘180 or ‘839 Patent. (*Id.* at Q. 20, 23). Finally, the jury found that once Marvell learned of the ‘180 and ‘839 Patent, there was clear and convincing evidence that Marvell actually knew or should have known that its actions would infringe both Claim 2 of the ‘180 Patent and Claim 4 of the ‘839 Patent. (Docket No. 21, 24).

III. PROCEDURAL HISTORY

CMU filed its complaint in this case on March 6, 2009. (Docket No. 1). Since then this case had gone through extensive discovery and motions practice, including a Motion to Transfer⁴³ (Docket No. 55), Claim Construction⁴⁴ (Docket No. 143), and several rounds of Summary Judgment proceedings.⁴⁵

⁴³ On July 7, 2009 Marvell filed a Motion to Transfer the case to the Northern District of California, which, after briefing and oral argument, was denied on September 21, 2009. (Docket Nos. 25; 26; 31; 33; 36; 45; 50; 54; 55). Marvell then filed its Amended Answer on April 29, 2010, and CMU filed its Answer and Affirmative Defenses to same on May 28, 2010. (Docket Nos. 116; 127).

⁴⁴ The Court held a seven hour Technology Tutorial with the parties’ experts Dr. McLaughlin and Dr. Proakis, in preparation for claims construction. (Docket Nos. 104; 143). The Court then held a two day *Markman* hearing. (Docket Nos. 104-106). Upon consideration of the parties’ arguments, briefs, and materials submitted in support, as well as with the aid of the Court’s Technical Advisor, Dr. Daniel Costello, the Court issued an order on the meaning of the disputed claims. (Docket Nos. 175; 176); *see also Markman v. Westview Instruments, Inc.*, 517 U.S. 370, 377-90 (1996). The Court entered its Pretrial Order on October 10, 2011, scheduling jury selection and trial and setting other pretrial hearings and deadlines. (Docket No. 315); *see also* (Docket Nos. 78; 79; 80; 81; 82; 83; 84; 89; 90; 91; 93; 94; 95; 105; 106; 108; 109; 110; 118; 119; 120; 128; 129; 142; 146).

⁴⁵ This Court denied Marvell’s First Motion for Partial Summary Judgment of Invalidity of U.S. Patent Nos. 6,201,839 and 6,438,180, its Second Motion for Partial Summary Judgment of Invalidity and subsequent Motion for Reconsideration of said denial of the Second Motion for Partial Summary Judgment upon consideration of the parties’ briefs, declarations and oral argument. (Docket Nos. 218; 306; 307; 318; 337; 339; 423). The parties filed their Summary Judgment Motions and *Daubert* Motions, along with briefs, declarations, and statements of facts in support and opposition in the spring of 2012. The Court heard argument on these motions from July 10 through July 11, 2012. (Docket Nos. 433; 438-440). The Court granted, in part, and denied, in part, Marvell’s Motions for Partial Summary Judgment of No Infringement and No Damages with Respect to Extraterritorial Conduct and for Partial Summary Judgment of No Infringement and No Damages with Respect to Licensed Use. (Docket Nos. 356; 360; 441; 442). The Court granted Marvell’s Motion for Partial Summary Judgment of non-infringement with respect to Claims 11, 16, 19 and 23 of U.S. Patent No. 6,201,839 and Claim 6 of U.S. Patent No. 6,438,180. (Docket Nos. 352; 443; 444). Further, the Court granted, in part, and denied, in part, Marvell’s Motion to Exclude the Testimony of

Following the Court's Summary Judgment and *Daubert* rulings, and upon consideration of the parties' pretrial proffers,⁴⁶ the Court convened a two-day hearing on October 17 and October 18, 2012 to address nineteen Motions *in limine* (five by CMU and fourteen by Marvell). (Docket Nos. 578; 579; 590; 591). The Court issued rulings shortly thereafter.⁴⁷ (Docket Nos. 595; 596; 601; 602; 604; 605; 607-614).

On November 9, 2012, the parties filed their responses to objections to exhibits, responses to objections to deposition designations,⁴⁸ joint stipulations, proposed jury instructions, proposed limiting instructions, proposed *voir dire*, and proposed verdict slips.⁴⁹ See (Docket Nos. 615-626; 640-644). The Court held a lengthy two-day Pretrial Conference on November 14 and 15, 2012, during which objections to exhibits were ruled upon and arguments on trial issues were heard. (Docket Nos. 636; 638; 645; 648; 650; 653). The parties subsequently

Christopher Bajorek. (Docket Nos. 364; 445; 446). The Court denied CMU's Motion to Exclude Opinion Testimony Regarding Purported Acceptable, Non-Infringing Alternatives. (Docket Nos. 373; 447; 448). CMU's Motion to Exclude Certain Opinion Testimony of Creighton G. Hoffman was granted, in part, and denied, in part. (Docket Nos. 370; 449; 450). Finally, Marvell's Motion to Exclude the Opinions of Catherine M. Lawton was granted, in part, and denied, in part. (Docket Nos. 367; 451; 452).

⁴⁶ CMU filed its Pretrial Statement on September 12, 2012, and Marvell filed its modified Pretrial Statement on September 24, 2012. (Docket Nos. 461; 481). Witness Lists and Offers of Proof were filed on October 8, 2012 and October 15, 2012, by CMU and Marvell, respectively. (Docket Nos. 538; 575).

⁴⁷ In accordance with the Pretrial Order, on September 24, 2012, the parties filed their Motions *in Limine* with briefs in support, and both filed responses to same on October 9, 2012. (Docket Nos. 483-525; 555-571).

⁴⁸ Exhibits, Objections to Exhibits, Responses to Objections to Exhibits, Deposition Designations, Objections to Deposition Designations, and Responses to Objections to Deposition Designations had been previously submitted but were stricken by the Court's October 24, 2012 Order. (Docket No. 586). The parties had presented the Court with more than 2,700 exhibits and hundreds of deposition designations and counter depositions which they claimed they might use at trial. Through the series of filings, the parties objected to nearly every exhibit, deposition designation, and counter designation of their opponent in some fashion. Accordingly, the Court struck these submissions and ordered the parties to meet and confer to resolve disputes. (Docket No. 586). By November 9, 2012, the parties had narrowed their disputes to 335 exhibits and reserved deposition disputes until the deposition's confirmed use at trial. (Docket Nos. 615-620; 631; 632; 640; 644).

⁴⁹ The Court struck the parties proposed final jury instructions and verdict slip for violating the Court's directive to submit joint proposals, as the parties offered only twelve, out of a total thirty-seven, agreed upon proposed jury instructions, few relating to the substantive law in the case, and two completely separate verdict forms. (Docket Nos. 623; 626; 627). The parties were ordered to meet and confer to resolve disputes. On December 19, 2012, the parties submitted joint instructions and verdict slips to the Court by email, and the Court ruled on disputes on the record during the Charge Conference. (Docket No. 764).

submitted trial briefs on the issues of law that would need to be addressed by the Court during trial. (Docket Nos. 647; 652).

Jury selection proceeded as scheduled on November 26, 2012, and trial began on November 28, 2012. (Docket Nos. 666; 669; 671). The Court heard argument, accepted briefing, and ruled on a number of motions made during trial regarding witnesses, exhibits, and points of law.⁵⁰ The parties agreed that the Plaintiff, CMU would not rest its case until the conclusion of testimony by three defense witnesses.⁵¹ Once CMU rested its case, Marvell moved for judgment as a matter of law on “Non-infringement,” “No Damages,” and “No Willful Infringement.” (Docket Nos. 703; 701; 699). At the end of Marvell’s evidence, CMU moved for “Judgment As a Matter of Law on Marvell’s Invalidity Defenses.” (Docket No. 731). Following CMU’s rebuttal, Marvell filed a Motion for Judgment as a Matter of Law on Invalidity, and renewed its earlier Motions for Judgment as a Matter of Law on Non-Infringement, No Damages, and No Willful Infringement. (Docket Nos. 738; 740; 742; 747). The Court denied these motions on the record

⁵⁰ The Court will not discuss in depth the substance of these motions. *See* (Docket Nos. 656; 672; 679-681; 683-685; 687-698; 705; 712-720; 722-724; 727; 728; 730; 733; 735; 737; 744-746; 751; 753; 755-757) (denying Marvell’s request for the Court to submit the issue of laches to the jury on an advisory basis; denying Marvell’s Emergency Motion to Strike CMU’s Attempt to Include Non-infringing Sales of Chips that Are Never Used in the U.S. in the Damages Case It Intends to Present to the Jury; granting Marvell’s Motion for Extension of Time for trial; denying CMU’s Motion For Leave to Recall Dr. Kryder; granting in part and denying in part Marvell’s Motion to Exclude the Testimony of Catherine Lawton; granting Marvell’s Motion for Reconsideration re: Court’s Order Sustaining CMU’s Objections to Disputed Defendants’ Exhibit DX-189; denying Marvell’s Oral Motion to “Strike Slide 19 of Plaintiff’s Demonstrative and Associated Testimony”; granting in part and denying in part CMU’s Rebuttal Witness List/Offer of Proof; denying CMU’s Motion to Strike Testimony of Marvell Expert Creighton Hoffman; Plaintiff’s Motion to Strike Testimony of Marvell Expert Richard Blahut and Enter Judgment of Infringement for Accused MNP Chips and Simulators; denying Marvell’s Motion to Strike Certain Testimony of Catharine M. Lawton; granting in part and denying in part CMU’s “Motion in Limine to Strike Testimony and to Preclude Argument Relating to Marvell’s Pre-Suit Communications with Counsel”; and denying without prejudice Marvell’s Motion for Mistrial).

⁵¹ In accordance with the Court’s October 20, 2011 Pretrial Order (Docket No. 315), counsel were limited to twenty hours per side to present their case to the jury. Despite having proposed said time limit, Marvell moved for an extension of trial time. (Docket No. 687). The Court granted said motion, allowing twenty-five hours per side including opening statements, direct examination, cross examinations, and closing arguments. (Docket No. 710). Since the parties were “on the clock,” they had a “gentlemen’s agreement” that certain witnesses that would have been called by both parties, in the interest of saving time, would only be called once, with cross examination allowed to go beyond the scope of the direct examination. The Court was not privy to this agreement but was told that this agreement applied to the testimony of Marvell engineers: Mr. Doan, Dr. Wu, and Mr. Burd.

(Docket No. 759 at 52-53), with the parties requesting the Court to explain its rulings in written opinions. (Docket No. 764 at 99). The Court then charged the jury on December 21, 2012, and it returned its verdict on December 26, 2012. (Docket No. 762). As noted, the jury found for CMU on infringement, validity, and willfulness, and awarded damages to CMU in the amount of \$1,169,140,271.00. (*Id.*). The Court entered the parties' joint proposed form of judgment on January 14, 2013. (Docket No. 769).

Pursuant to the Court's scheduling order, (Docket No. 763), on February 11, 2013, Marvell filed a Motion for Judgment as a Matter of Law or in the Alternative, Motion for New Trial on Non-Damages Issues, specifically for Non-Infringement, Invalidity, No-Willfulness, and CMU Misconduct (Docket Nos. 805; 806), Motion for Judgment as a Matter of Law, Motion for New Trial And/Or Motion for Remittitur with Respect to Damages, (Docket Nos. 807; 808), and Motion for Judgment on Laches. (Docket Nos. 802-04).

CMU moved for "Permanent Injunction, Post Judgment Royalties, and Supplemental Damages" (Docket Nos. 786; 787), "Prejudgment Interest" (Docket Nos. 788; 789), "A Finding of Willful Infringement and Enhanced Damages" (Docket Nos. 790; 793), and "Attorneys' Fees Pursuant to 35 U.S.C. Section 285" (Docket Nos. 794; 810; 811).

These matters have been completely briefed (Docket Nos. 823-829; 832-837; 849-855; 857-863), and the Court heard oral argument on same from May 1 to May 2, 2013. (Docket Nos. 872-874). In earlier opinions, the Court had denied, without prejudice, CMU's Request for Attorneys' Fees (Docket No. 884), and denied Marvell's Motion for a New Trial on the Grounds of CMU Misconduct. (Docket No. 900). The Court now turns to the parties' Motions for JMOL, Motions for a New Trial, and Motion for Remittitur. (Docket Nos. 805; 807).

IV. LEGAL STANDARD⁵²

A. Judgment as a Matter of Law

It is well-established that a motion for judgment as a matter of law “should be granted only if, viewing the evidence in the light most favorable to the non-moving party, there is no question of material fact for the jury and any verdict other than the one directed would be erroneous under the governing law.” *Galena v. Leone*, 638 F.3d 186, 196 (3d Cir. 2011) (quoting *Beck v. City of Pittsburgh*, 89 F.3d 966, 971 (3d Cir. 1996)).⁵³ Accordingly, the Court must determine “whether there are any genuine issues of material fact such that a reasonable jury could return a verdict for [the non-moving party].” *McGreevy v. Stroup*, 413 F.3d 359, 364 (3d Cir. 2005) (quoting *Debiec v. Cabot Corp.*, 352 F.3d 117, 128 n.3 (3d Cir. 2003)) (alteration in original); *see also Trueman v. City of Upper Chichester*, 289 F. App’x. 529, 540 (3d Cir. 2008) (affirming denial of Rule 50(a) motion because “the jury could not reasonably have found in [the non-movant’s] favor on his claim against the [movant]”).

In ruling on a Rule 50(a) motion, the Court “must refrain from weighing the evidence, determining the credibility of witnesses, or substituting our own version of the facts for that of the jury.” *Eschelman v. Agere Sys.*, 554 F.3d 426, 433 (3d Cir. 2009) (citing *Marra*, 497 F.3d at 300). “Although judgment as a matter of law should be granted sparingly,” it should be granted where “the record is critically deficient of the minimum quantum of evidence” necessary to support a verdict in favor of the non-moving party. *Id.* (quoting *Gomez v. Allegheny Health*

⁵² While this is a patent case, Third Circuit law governs the Court’s analysis of the parties’ motions for judgment as a matter of law and motions for a new trial. *See Leader Technologies, Inc. v. Facebook, Inc.*, 678 F.3d 1300, 1305 (Fed. Cir. 2012), *cert. denied*, 133 S. Ct. 889 (2013).

⁵³ Courts apply the same standard to motions pursuant to Rule 50(a) and Rule 50(b) of the Federal Rules of Civil Procedure. *See Galena*, 638 F.3d at 196 (reviewing Rule 50(b) motion by using standard articulated in *Beck*, 89 F.3d at 971, which articulated the Rule 50(a) standard); *McDaniels v. Flick*, 59 F.3d 446 (3d Cir. 1995) (applying the same standard to the review of both Rule 50(a) and Rule 50(b) motions); *Foradori v. Harris*, 523 F.3d 477, 485 n.8 (5th Cir. 2008) (“We apply this same 50(a) standard when we review a renewed motion for judgment as a matter of law under 50(b).”).

Servs., Inc., 71 F.3d 1079, 1083 (3d Cir. 1995)). To that end, “a scintilla of evidence is not enough” to survive a Rule 50 motion at trial. *Johnson v. Campbell*, 332 F.3d 199, 204 (citing *Goodman v. Pa. Turnpike Comm’n.*, 293 F.3d 655, 664-65 (3d Cir. 2002)). The question is not whether there is literally no evidence supporting the unsuccessful party, but whether there is evidence upon which a reasonable jury could properly find a verdict in favor of the non-moving party. *Gomez*, 71 F.3d at 1083. In other words, “a directed verdict is mandated where the facts and the law will reasonably support only one conclusion.” *McDermott Int’l, Inc. v. Wilander*, 498 U.S. 337, 356 (1991) (citation omitted).

B. Motion for New Trial

A motion for a new trial pursuant to Federal Rule of Civil Procedure 59 can be granted “to all or any of the parties and on all or part of the issues in an action in which there has been a trial by jury.” FED. R. CIV. P. 59(a). The Court is also “empowered to order a new trial on its own initiative ‘for any reason that would justify granting one on a party’s motion.’” *Pryer v. C.O. 3 Slavic*, 251 F.3d 448, 453 (3d Cir. 2001) (quoting FED. R. CIV. P. 59(d)). A new trial is most commonly granted in select situations, including: (1) when the jury’s verdict is against the clear weight of the evidence; (2) when new evidence surfaces that would have altered the outcome of the trial; (3) when improper conduct on the part of an attorney or the court unfairly influenced the verdict; or (4) where the jury’s verdict was facially inconsistent. *Davis v. Mountaire Farms, Inc.*, 598 F. Supp. 2d 582, 587 (D. Del. 2009).

The Court’s level of discretion varies, depending on the type of error alleged. *Moussa v. Commonwealth of Pennsylvania Dep’t of Pub. Welfare*, 289 F. Supp. 2d 639, 648 (W.D. Pa. 2003) (citing *Klein v. Hollings*, 992 F.2d 1285, 1289-90 (3d Cir. 1993)). When the motion for a new trial is based on the claim that the verdict is against the clear weight of the evidence, the

Court's discretion is limited—the verdict must be “contrary to the great weight of the evidence; that is, where a miscarriage of justice would result if the verdict were to stand.” *Pryer*, 251 F.3d at 453. A verdict may not be set aside when there is a plausible or rational basis for the decision. *Moussa*, 289 F. Supp. 2d at 648. The Court must not substitute its own judgment of the facts and assessment of the witnesses' credibility for the jury's. *Davis*, 598 F. Supp. 2d at 587. When the basis for the motion is an alleged error on the part of the court, such as an error in jury instructions or evidentiary rulings, a district court must first determine whether an error was made, i.e., “whether, taken as a whole, the instruction properly apprised the jury of the issues and the applicable law.” *Donlin v. Philips Lighting N. Am. Corp.*, 581 F.3d 73, 78 (3d Cir. 2009). If there was an error, the court must then determine “whether that error was so prejudicial that refusal to grant a new trial would be ‘inconsistent with substantial justice.’” *Bhaya v. Westinghouse Elec. Corp.*, 709 F. Supp. 600, 601 (E.D. Pa. 1989) (quoting FED. R. CIV. P. 61). “Generally, a party is not entitled to receive a new trial for objections to evidence that he did not make at or prior to the initial trial, even if they may have been successful.” *Ashford v. Bartz*, Civ. No. 04-642, 2010 WL 272009, at *4 (M.D. Pa. 2010) (citations omitted); *see also Kiewit Eastern Co., Inc. v. L & R Constr. Co., Inc.*, 44 F.3d 1194, 1204 (3d Cir. 1995) (“Courts often take a dim view of issues raised for the first time in post-judgment motions. Generally, this is a decision within the sound discretion of the district court.”).

V. DISCUSSION

With these standards in mind, the Court discerns substantial evidence upon which a reasonable jury could have found in favor of the non-movants for each of the filed Motions challenging the evidence.

A. Infringement

CMU had the burden of proving its claims of direct and indirect infringement pursuant to 35 U.S.C. §§ 271(a), (b) and (c). It alleged that Marvell’s chips and simulators infringe Claim 4 of the ‘839 Patent and Claim 2 of the ‘180 Patent. To that end, it produced the opinion testimony of Dr. McLaughlin, who testified over the course of two days. (Docket Nos. 677; 678). Against same, Marvell moved for JMOL on the grounds that CMU had not presented sufficient evidence that a reasonable jury could find infringement by Marvell, or, in the alternative, for a new trial. (Docket Nos. 703; 805).

1. Legal Standard

Direct infringement of a U.S. patent occurs when a party, “without authority makes, uses, offers to sell, or sells any patented invention, within the United States.” 35 U.S.C. § 271(a). Method claims are not infringed simply by the sale of an apparatus that is capable of infringing use. *Ormco Corp. v. Align Tech., Inc.*, 463 F.3d 1299, 1311 (Fed. Cir. 2006); *Standard Havens Products, Inc. v. Gencor Industries, Inc.*, 953 F.2d 1360, 1374 (Fed. Cir. 1991). “Because a process is nothing more than the sequence of actions of which it is comprised, the use of a process necessarily involves doing or performing each of the steps recited.” *NTP, Inc. v. Research in Motion, Ltd.*, 418 F.3d 1282, 1318 (Fed. Cir. 2005). Thus, direct infringement of a method claim only occurs if each step of the claimed method is actually performed. *See Muniauction, Inc. v. Thomson Corp.*, 532 F.3d 1318, 1328 (Fed. Cir. 2008).

In this case, the only form of direct infringement at issue is literal infringement. Marvell literally infringes if Marvell’s chips and simulators use a method that includes each and every method step in Claim 4 of the ‘839 Patent or Claim 2 of the ‘180 Patent. *Akamai Techs., Inc. v. Limelight Networks, Inc.*, 692 F.3d 1301, 1307 (Fed. Cir. 2012). If Marvell’s methods as

employed by its chips and simulators do not contain one or more method steps in that patent claim, Marvell does not directly infringe that claim. *Id.* Accordingly, literal infringement must be determined with respect to each patent claim, individually.

There are also two forms of indirect infringement: inducing infringement and contributory infringement. These modes of infringement are governed, respectively, by 35 U.S.C. § 271(b) and (c).

To prove inducement of infringement and contributory infringement, CMU must first prove there is direct infringement. *Akamai Techs.*, 692 F.3d at 1308. Second, “inducement requires that the alleged infringer knowingly induced infringement and possessed specific intent to encourage another’s infringement.” *DSU Med. Corp. v. JMS Co.*, 471 F.3d 1293, 1306 (Fed. Cir. 2006) (en banc) (internal quotation marks omitted); *see also Global-Tech Appliances, Inc. v. SEB S.A.*, ___ U.S. ___, 131 S. Ct. 2060, 2068 (2011). It is enough that the inducer “cause[s], urge[s], encourage[s], or aid[s]” the infringing conduct and that the induced conduct is carried out. *Akamai Techs.*, 692 F.3d at 1308 (internal citations omitted, emphasis added). A defendant must “actively induce” infringement which “require[s] knowledge of the existence of the patent that is infringed” or taking “deliberate actions to avoid confirming a high probability of wrongdoing.” *Global-Tech*, 131 S. Ct. at 2068-2070. Thus, induced infringement occurs if Marvell actively induces someone else, such as one of Marvell’s customers, to use a method that is covered by Claim 4 of the ‘839 Patent or Claim 2 of the ‘180 Patent. *Id.*

To prevail on a claim for contributory infringement, it must be shown that an infringer sold, offered to sell, or imported into the United States a component of an infringing product “knowing [the component] to be especially made or especially adapted for use in an infringement of such patent, and not a staple article or commodity of commerce suitable for substantial non

infringing use.” 35 U.S.C. § 271(c); *see Lucent Techs. v. Gateway, Inc.*, 580 F.3d 1301, 1320 (Fed. Cir. 2009). Thus, in this instance, contributory infringement occurs if Marvell sold or offered for sale a material component of the patented invention that was not a staple article of commerce, and which Marvell knew was specifically made for use in practicing the claimed methods of either Claim 4 of the ‘839 Patent or Claim 2 of the ‘180 Patent. As with induced infringement, a claim for contributory infringement must contain allegations of the requisite knowledge of the patent-in-suit at the time of infringement. *Mallinckrodt*, 670 F. Supp. 2d at 355; *see also Global-Tech*, 131 S. Ct. at 2068. In addition, the patentee bears the burden of proving that the accused products have no substantial non-infringing uses. *See Golden Blount, Inc. v. Robert H. Peterson Co.*, 438 F.3d 1354, 1363 (Fed. Cir. 2006).

Before delving into its analysis, the Court notes that expert testimony is not necessary to prove infringement. In a case involving complex technology, however, the Federal Circuit has “repeatedly approved the use of expert testimony to establish infringement” and indeed “where the accused infringer offers expert testimony negating infringement, the patentee cannot satisfy its burden of proof by relying only on testimony from those who are admittedly not experts in the field.” *Centricut, LLC v. Esab Grp., Inc.*, 390 F.3d 1361, 1370 (Fed. Cir. 2004).

In reaching its decision, the Court has considered all of the parties’ arguments raised in their briefs and at trial, arguments made at the motion hearing held on May 1 and May 2, 2013, the transcript thereof, and the entire trial record along with the parties’ latest submissions. (Docket Nos. 703; 704; 729; 742; 743; 805; 806; 827; 851; 857; 880; 881).

2. Direct Infringement

As the party alleging infringement of the method claims at issue, CMU must demonstrate that Marvell practices every step of the claimed method. *See Muniauction*, 532 F.3d at 1328. At

trial, CMU called Dr. Steven McLaughlin to provide expert technical testimony about CMU's patents and whether they are infringed by Marvell's MNP-type chips, NLD type chips, and related simulators. Dr. McLaughlin analyzed the documents produced by Marvell concerning the MNP, EMNP, NLD, and Simulator Technology and the Chip Stip. (Pl. Ex. 823).

a. MNP/EMNP Chips

To begin, Marvell asserts that no reasonable jury could find that the accused MNP/EMNP Chips infringe because: (1) they do not select a branch metric function for each of the branches of the trellis at a certain time index; (2) they do not apply each of said branch metric functions to a plurality of signal samples; and (3) the MNP/EMNP module does not determine branch metric values for branches of a trellis. (Docket No. 743). CMU counters that its expert Dr. McLaughlin has demonstrated otherwise through his mapping of the claims onto the Accused Technology. (Docket Nos. 704; 743).

CMU asserted that Marvell's MNP Chips first infringed Claim 4 of the '839 Patent. Claim 4 of the '839 Patent provides:

[a] method of determining branch metric values for branches of a trellis for a Viterbi-like detector, comprising:
 selecting a branch metric function for each of the branches
 at a certain time index from a set of signal-
 dependent branch metric functions; and
 applying each of said selected functions to a plurality of
 signal samples to determine the metric value
 corresponding to the branch for which the applied
 branch metric was selected wherein each sample
 corresponds to a different sampling time instant.

'839 Patent col.14 ll.10-19.

In order to show infringement of the '839 Patent, Dr. McLaughlin broke this claim into three "elements." First, he mapped "a method of determining branch metric values for branches of a trellis for a Viterbi-like detector" onto the MNP technology via the circuits of the Chip Stip

by showing how the MNP: (1) is a detector; (2) computes branch metric values for branches of a trellis; and (3) is a Viterbi-like detector. (Docket No. 677 at 86-120). On this point, CMU also proffered supporting internal Marvell documents, such as the 88c7500M Specification from August 2004, which stated the “MNP is an advanced post processing adaptive detector,” and Mr. Burd’s “Media Noise Processor” write up, which stated the “MNP is used to properly take media noise into account during the detection processor.” (Pl. Exs. 472; 408) In addition, the “DSP Technical Presentation 5: Data Detection” by Dr. Hongxin Song from 2009 stated “Media noise post-processor is a partial nonlinear detector in data dependent noise channel.” (Pl. Ex. 770). This exhibit also contained circuit drawings of the MNP, trellis models, and detailed the “steps to calculate nonlinear branch metric.” (*Id.*).

Second, Dr. McLaughlin pointed out where the MNP technology contained a method for “selecting a branch metric function for each of the branches at a certain time index from a set of signal-dependent branch metric functions” on the circuits from Exhibit A of the Chip Stip. (Docket No. 677 at 108-117). Third, Dr. McLaughlin used Exhibit A of the Chip Stip to demonstrate how the MNP used a method “applying each of said selected functions to a plurality of signal samples to determine the metric value corresponding to the branch for which the applied branch metric was selected wherein each sample corresponds to a different sampling time instant.” (*Id.* at 118-119). He explained that the FIR filter implements the function and applies it to the plurality of signal samples which then computes the metric value, wherein each sample corresponds to a different time instant, referred to as “D.” (*Id.*). After finding that each of the elements of Claim 4 of the ‘839 Patent was used by the MNP technology, Dr. McLaughlin opined that the MNP infringed Claim 4 of the ‘839 Patent. (*Id.* at 120).

Likewise, CMU claimed Marvell's MNP technology infringed Claim 2 of the '180 Patents, which incorporates Claim 1. Claims 1 and 2 of the '180 Patent claim:

1. A method of determining branch metric values in a detector, comprising:
 - receiving a plurality of time variant signal samples, the signal samples having one of signal-dependent noise, correlated noise, and both signal dependent and correlated noise associated therewith;
 - selecting a branch metric function at a certain time index;
 - and
 - applying the selected function to the signal samples to determine the metric values.
2. The method claim 1, wherein the branch metric function is selected from a set of signal-dependent branch metric functions.

'180 Patent col.15 ll.39-51.

Given same, Dr. McLaughlin divided these claims into five "elements" and walked the jury through how each was mapped on to the accused MNP circuits. He showed how some of the language of the '180 Patent was the same as the '839 Patent and explained that there was no need to go through the circuit schematics again since the methods were being applied to the same circuit. (Docket No. 677 at 120-125). He "checked off" that he had already demonstrated that the MNP technology involved: (1) "a method of determining branch metric values in a detector, comprising"; (2) "selecting a branch metric function at a certain time index;" and (3) "applying the selected function to the signal samples to determine the metric values;" and (4) "the method claim 1, wherein the branch metric function is selected from a set of signal-dependent branch metric functions." (*Id.*).

On the remaining element, Dr. McLaughlin explained how the MNP technology used a method of "receiving a plurality of time variant signal samples, the signal samples having one of signal-dependent noise, correlated noise, and both signal dependent and correlated noise associated therewith," which was consistent with the second element of Claim 1 of the '180

Patent. (Docket No. 677 at 122). Based on his knowledge and expertise in the field, as well the Marvell DSP Technical Presentation slides titled “Data Dependent Noise” and “Noise Correlation,” he showed that the MNP technology used this last element. (Pl. Ex. 770). He also noted that there was no requirement in the ‘180 Patent that the detector be a Viterbi-like detector. (Docket No. 677 at 121). In light of his prior conclusion that each of the elements of Claim 2 of the ‘180 Patent, through which the elements of Claim 1 are incorporated, was used in the MNP technology, he concluded that the MNP infringed Claim 2 of the ‘180 Patent. (*Id.* at 123).

b. NLD Chips

Marvell next argues that no reasonable jury could find that Accused NLD Chips infringe because, again: (1) the chips do not select a branch metric function for each of the branches of the trellis at a certain time index; (2) the chips do not apply each of said branch metric functions to a plurality of signal samples; and (3) the NLDs do not determine branch metric values for branches of a trellis. (Docket No. 743).

As with the MNP and EMNP chips, Dr. McLaughlin started with the ‘839 Patent and mapped the first element, “a method of determining branch metric values for branches of a trellis for a Viterbi-like detector” onto the NLD circuits from Exhibit D of the Chip Stip. (Docket No. 677 at 140-142). Dr. McLaughlin broke this down further, and showed how the NLD: (1) is a detector; (2) computes branch metric values for branches of a trellis; and (3) is a Viterbi-like detector. (*Id.* at 140-143). Dr. McLaughlin based his conclusions on his analysis, using his personal knowledge and expertise in this area, and he also explicitly relied on Marvell documents, such as the presentation titled “Nonlinear Viterbi Detector Application Note – C8830R1.0” by Dr. Hongxin Song. (Pl. Ex. 596).

In light of the Chip Stip, Dr. McLaughlin opined that the NLD technology contained a method for “selecting a branch metric function for each of the branches at a certain time index from a set of signal-dependent branch metric functions.” (Docket No. 677 at 142-144). He demonstrated this on the circuit drawing and referenced supporting testimony from Marvell engineer Mr. Burd.⁵⁴ (*Id.* at 145-146).

Last, for the ‘839 Patent, Dr. McLaughlin relied on Exhibit D of the Chip Stip to conclude that the NLD used a method “applying each of said selected functions to a plurality of signal samples to determine the metric value corresponding to the branch for which the applied branch metric was selected wherein each sample corresponds to a different sampling time instant.” (Docket No. 677 at 146-149). He highlighted the location on the circuit diagrams of the plurality of signal samples, the application of the branch metric function, and the branch metric value. (*Id.*). CMU also offered deposition testimony from Mr. Burd, who stated that “[a]nd so in fact noise whitening filter is a parameter of the branch metric function,” as well as Dr. Song’s Application Note, to further support Dr. McLaughlin’s conclusion. (*Id.* at 149; Pl. Ex. 596). Given that Dr. McLaughlin demonstrated how each of the elements of Claim 4 of the ‘839 Patent was found to be used in the NLD technology, he opined that the NLD infringed Claim 4 of the ‘839 Patent. (Docket No. 677 at 149-150).

Moving on to Claim 2 of the ‘180 Patent, Dr. McLaughlin stated that his analysis showed that the NLD technology involved: (1) a method of determining branch metric values in a

⁵⁴ As Marvell’s Rule 30(b)(6) deposition witness on the technology-in-suit, Mr. Burd stated:

Q: And it is possible that for a different branch of the Viterbi trellis that the f0, f1, f2, and f3 valued can be different.

A: Yes it is possible. So basically we’re using a branch metric function that is parameterized in terms of --....Parameterized in terms of branch—branch metric, branch—sorry—branch index, and so for different branches you would choose different set of parameters.

(Docket No. 726).

detector; (2) a detector selecting branch metric functions; (3) application of the selected function; (4) wherein the branch metric function is selected from the set of signal dependent branch functions; and finally (5) that it received a plurality of time variant signal samples, those having one of signal dependent noise and correlated noise. (Docket No. 677 at 154-156). He did not walk through the circuits again as he had already demonstrated his analysis in those respects. Because Dr. McLaughlin gave expert opinion testimony that each of the elements of Claim 2 of the ‘180 Patent, through which the elements of Claim 1 are incorporated, used the NLD technology, he concluded that the NLD infringed Claim 2 of the ‘180 Patent. (*Id.*).

c. Simulators

Marvell also contends that the Accused Simulators do not infringe as a matter of law. (Docket No. 743 at 5-7). It alleges that the ‘839 Patent is directed to a method of determining branch metric values for branches of a trellis for a Viterbi-like “**detector**.” (*Id.* at 5) (emphasis in original). Similarly, it claims that the ‘180 Patent is directed to a “method of determining branch metric values in a **detector**.” (*Id.* at 5-6) (emphasis in original). Because Marvell’s simulators are not detectors and do not process actual signal samples, they are not implicated by either patent. (*Id.* at 6-7).

In support, Marvell cites to *Harris Corp. v. Ericsson Inc.* for the proposition that “as a matter of law, running a simulator program does not constitute actually performing the claimed methods in a detector for processing signal samples.” 417 F.3d 1241, 1256 (Fed. Cir. 2005). The *Harris* case involved a method of using a communication system which could “be directly infringed only by one who uses the system, not by one who makes or sells the components of the system.” *Id.* at 1256. In *Harris*, the Federal Circuit focused on the fact that the plaintiff had submitted only a flow chart describing a “simulation program” and had not shown that the

“claimed method is actually carried out, rather than simulated, when Ericsson runs this program.” *Id.* (emphasis added). Accordingly, the plaintiff had failed to present evidence of the method being carried out by the program. *Id.* Nevertheless, the Federal Circuit did not create a bright line rule about simulation programs. As described herein, CMU has presented enough evidence to persuade the trier of fact that the claimed method in this case is actually carried out on the challenged simulators.

Upon examination of the Accused Simulators, Dr. McLaughlin opined at trial “that Marvell’s simulators infringed the asserted claims.” (Docket No. 677 at 83). In reaching this conclusion, he studied the code of five simulators provided by Marvell in discovery: (1) the KavcicPP Simulator; (2) the MNP Simulator; (3) the EMNP Simulator; (4) the NLD Simulator; and (5) the KavcicViterbi Simulator. (*Id.* at 156-166). The first four simulators correspond to particular chips and the last is used as a benchmark. (*Id.* at 169). Dr. McLaughlin described the simulators’ use by Marvell: (1) to research and develop the chips; (2) to verify the chips’ hardware design; and (3) to provide simulation code to customers so that they may, in turn, evaluate the performance and functionality of Marvell’s chips. (*Id.* at 158). This testimony was supported by the deposition testimony of the Marvell corporate designee on this technology, Greg Burd, in which he stated “C Code which is used in our simulation. So we provide a version of the same C code to the designers to be used to serve as a golden source of test vectors to verify the design against.” (*Id.* at 169-170).

Dr. McLaughlin analyzed the simulator code (Pl. Ex. 106), and he compared lines of code to the circuits of the chip. (Docket No. 677 at 156-166). He demonstrated how the simulators mimic the chips and how the different elements of the claims were covered by the code. (*Id.*). Further, Dr. McLaughlin determined that there was a one-to-one match between what was in the

computer code and what was being calculated in the circuitry. (*Id.*). Dr. McLaughlin showed this for each of the first four simulators. (*Id.*). Based on his conclusion that the chips infringed each and every claim, he determined the simulators also infringed. (*Id.*).

For the KavcicViterbi Simulator, Dr. McLaughlin similarly analyzed the code in question. (*Id.* at 166-173). In doing so, Dr. McLaughlin looked at testimony by Marvell on how it uses this particular simulator. For example, Mr. Doan, then a Marvell engineer, stated that the KavcicViterbi Simulator was used as the benchmark and that they “continuously run Kavcic algorithm to benchmark any subsequent algorithm we develop at Marvell.” (*Id.* at 171-172; Docket No. 761 at Jt. Ex. D at 137-138). Some of his analysis was also based on the testimony of Marvell engineer Mr. Burd, who stated in relevant part:

The way I do my research which might be different from other people, I first try to understand what’s available out there. So maybe look at some ideas which people came up with before me. ... To make sure that I do, in fact, understand what Professor Kavcic is trying to do and at the same time just to see kind of what’s out there. Right? And then I can use this code for benchmarking later. Right? For performance benchmarking later. So this was a launching pad for our research.

(Docket No. 677 at 170-173).

This (Plaintiff Ex. 93) is KavcicViterbi.cpp class, written by engineers in Marvell, and I do believe it contains the implementation, as understood by our architecture team of the IP which is taught in Professor Kavcic’s papers, and consequently in his patent.

(Docket No. 677 at 170-171; Pl. Ex. 93).

Although Marvell insists that its simulators do not process actual signal samples, Dr. McLaughlin maintained that the simulators do process both synthetic as well as real samples from a hard drive or hard drive disk. (Docket No. 677 at 174-178). To this end, he referred to two Marvell documents to support his conclusion, the first being an “Analysis and Design of

Viterbi Detector” which showed test results for a Toshiba wave form. The second document he used was an email from Marvell’s Mike Madden⁵⁵ to Hitachi, showing test results for wave form captured from the spin stand that were resampled, scaled, and fed into Marvell’s simulators. (Pl. Exs. 527; 341).

In sum, Dr. McLaughlin opined that: (1) the computer code directly mimics the chip; (2) the chip infringes each and every element of the claims of the CMU patent; and (3) the computer code and the simulator also infringe each and every element of the claims. While Marvell vigorously disagreed with all these opinions, both parties had an opportunity to make their opposing arguments on the nature of simulators to the jury. *See, e.g.*, (Docket No. 759 at 64-65) (“And [CMU] say yeah, simulated data; simulations, simulator. They know full well that when you sit down at a computer and you put in code and you simulate a formula, that’s not the detector. You’re not infringing anybody’s work when you do that. Everybody does it. They did it.”). The determination was purely factual and one which the jury alone would have to decide by weighing the offered evidence and the credibility of witnesses who testified to same. *Walker v. Gordon*, 46 F. App’x 691, 695 (3d Cir. 2002).

d. Direct Infringement in Sum

CMU presented sufficient evidence, through Dr. McLaughlin as well as supporting Marvell documents, that the MNP, EMNP, and NLD chip technology and the Accused Simulator technology use a method that includes each and every method step of Claim 4 of the ‘839 Patent and Claim 2 of the ‘180 Patent. Whether Dr. McLaughlin’s conclusions were persuasive or otherwise worthy of credence goes to the core of his credibility as a witness, and such

⁵⁵ The parties did not provide information to the jury about Michael Madden, but provided his deposition to the Court in the fall as part of possible depositions designations at trial. *See* (Docket No. 535). Therein, he stated he went with Marvell as a design engineer in 2000, and then rose up the ranks to be a senior design manager. *See* November 3, 2010 depo. at 19-23. He reports to Mr. Burd. *Id.*

“[d]eterminations regarding the weight to be accorded, and the sufficiency of, the evidence relied upon by the proffered expert are within the sole province of the jury.” *Walker*, 46 F. App’x at 695. Indeed, Marvell took advantage of the opportunity to rebut Dr. McLaughlin’s conclusions by offering opinion evidence through its own non-infringement expert Dr. Blahut that its products did not infringe CMU’s patents. (Docket No. 711 at 204-308). The jury was free to accept either expert’s opinions or reject them, as the “credibility of the parties’ competing experts is an issue for the jury to resolve, not the Court.” *Miller ex rel. Miller v. Evenflo Co., Inc.*, Civ. No. 09-108, 2011 WL 7037127, at *3 n.3 (W.D. Pa. Dec. 15, 2011); *see also Walker*, 46 F. App’x at 695.

Considering the evidence in the light most favorable to the nonmoving party, and giving it the advantage of every fair and reasonable inference in light of the undisputed facts, the Court finds there was adequate evidence upon which a reasonable jury could properly find a verdict in favor of CMU. Therefore, Marvell’s motion for JMOL and motion for a new trial on this issue is denied. The question of whether there was direct infringement by the Accused Chips and Accused Simulators was properly submitted to and decided by the jury.

3. Indirect Infringement

a. Inducement

Marvell asserts that it was entitled to a judgment as a matter of law or a new trial on CMU’s claims of indirect infringement for actively inducing infringement. (Docket No. 743, 805). It argues that CMU has not proven: (1) direct infringement; (2) that Marvell had actual knowledge of the patents-in-suit; and (3) that it specifically intended for others to perform acts that directly infringe one or more of the asserted claims. (*Id.*).

First, the Chip Stip lists the models of chips that correspond to the agreed-upon circuits that Dr. McLaughlin analyzed. (Pl. Ex. 823). These chips are sold to Marvell's customers to be used in hard disk drives, and they are also used by Marvell in research and development phases. (Docket No. 677 at 103-104, 178). As part of his testimony, Dr. McLaughlin analyzed the hardware and firmware settings of Marvell's customers such as Western Digital, Samsung, and Toshiba. (Pl. Exs. 1914; 1915; 1918; 1919). Once again, Dr. McLaughlin put forth expert testimony to prove direct infringement of Marvell's chips, thereby allowing CMU to advance a theory of induced infringement.⁵⁶

Second, in order to achieve success on induced infringement, CMU was required to show that Marvell had "knowledge of the existence of the patent" or took "deliberate actions to avoid confirming a high probability of wrongdoing." *Global-Tech*, 131 S. Ct. at 2068-70. To that end, CMU presented significant amounts of evidence to show Marvell's knowledge of the patents. Much of this evidence also supported CMU's claim of willful infringement, which is addressed later herein.⁵⁷

CMU proffered the following evidence of Marvell's knowledge of the patents-in-suit. First, is the email from Dr. Kavcic sent to Dr. Nazari at Marvell in 1998, providing a link to his publications, resume, and recent work. (Def. Ex. 1023). Second, is the January 3, 2002 email from Greg Burd to Toai Doan and Nersi Nazari, attaching a write up on the KavcicPP and stating "1. Kavcic's detection scheme is patented (assignee: Carnegie Mellon Univ. 2001)." (Pl. Ex. 280). Third, there is the January 4, 2002 weekly status report email from Mr. Burd to Mr. Doan,

⁵⁶ See discussion *supra* at Section V.A.2.

⁵⁷ See discussion *infra* at Section V.C.

Dr. Nazari, and Ke Han,⁵⁸ describing his work and stating “[a]nd of course as I mentioned earlier, Kavcic detector is also patented.” (Pl. Ex. 283). Such evidence indicated that Marvell knew of both the patents and the high likelihood that the Accused Technology infringed, especially given that the very people who designed the Accused Technology, i.e., the engineers, knew of the patents. (*Id.*).

In fact, Marvell hardly argued that it did not know of the CMU Patents; its theme throughout trial was that Dr. Kavcic’s work was its launching point only, and its technology was a “sub-optimal” version of Kavcic’s algorithm. (Docket No. 756). CMU replied that the MNP/NLD used the Kavcic algorithm, and optimality had no bearing on whether the claims of the Kavcic patented method were infringed. (*Id.*) In support, CMU proffered one of Dr. Wu’s weekly emails from January 10, 2003 that stated “1. MNP enhancement: Greg and I discussed the approach of using a different noise whitening filter for each branch. It turns out to be the original structure that Kavcic proposed in his paper.” (Pl. Ex. 366).⁵⁹ Thus, even if, as Marvell insists, it did not know the accused technologies infringed the patents-in-suit, CMU put forth sufficient evidence that a jury could find that Marvell was willfully blind in light of the high probability of infringement. *Global-Tech*, 131 S. Ct. at 2072. Once presented with the patents, Mr. Doan testified that he never looked at the patents, never directed others to look at them, and never contacted Marvell’s legal department about them. (Docket No. 761 Jt. Ex. D at 125, 130).

⁵⁸ Mr. Han was not deposed or called as a witness by either party. Based on his email address, he was a Marvell employee at the time said email was transmitted. (Pl. Ex. 283).

⁵⁹ As detailed later herein, Mr. Burd admits that at least the KavcicViterbi simulator used by Marvell during testing, was designed to encapsulate Dr. Kavcic’s work:

This (Plaintiff Ex. 93) is KavcicViterbi.cpp class, written by engineers in Marvell, and I do believe it contains the implementation, as understood by our architecture team of the IP which is taught in Professor Kavcic’s papers, and consequently in his patent.

(Docket No. 677 at 170-171; Pl. Ex. 93).

Despite same, he reported to Nersi Nazari on his January 14, 2002 status report that they would “continue work on non-linear detector based upon Kavcic’s model.” (Pl. Ex. 285).

Additionally, as to Marvell’s knowledge of the patents, CMU’s Technology Transfer representative Carl Mahler sent a letter in August 2003 to Marvell’s CTO Dr. Pantas Sutardja and Matthew Gloss, who was Marvell’s then General Counsel, stating that CMU held patents in the area of correlation-sensitive adaptive sequence detectors, “namely US Patent number 6,201,839 B1 and US Patent number 6,438,180 B1.” (Pl. Ex. 422, Pl. Ex. 431). Mr. Mahler attached the patents to the letter and encouraged Marvell to contact him if they found the patents to be of interest. (*Id.*). There was no response to these letters. (Docket No. 682 at 150). Similarly, Junya Suwanai of Fujitsu, “a customer for Marvell’s read channel i.e. 5575M, 7500M,” corresponded with Marvell in November 2004, stating that Fujitsu had received a license offer for the CMU Patents-in-suit. (Pl. Ex. 477). He wrote that “since it seems that these patents might be related to read channel, we would like to know, by the end of November, your opinion regarding relationship between CMU’s Patents and the above Marvell lead [*sic*] channel and the specific grounds/reasons for such opinion.” (*Id.*). No documents were found in relation to this letter, and Marvell’s corporate designee testified that he did not know of any response to this letter. (Docket No. 761 at Jt. Ex. C. at 534-535).

CMU had to prove that Marvell had the specific intent to encourage another’s infringement, which can be demonstrated if Marvell caused, urged, encouraged, or aided the infringing conduct. *DSU*, 471 F.3d at 1306; *Akamai Techs.*, 692 F.3d at 1308. On this point, CMU showed that Marvell aided its customers’ infringement by producing chips that used the accused methods and instructed its customers to use the chips in infringing modes. (Docket No. 677 at 180-183; Docket No. 678 at 91; Pl. Exs. 1913; 1918; 1919). Specifically, CMU entered

into evidence emails, firmware, as well as programming instructions for hardware showing that Marvell directed its customers, including Western Digital, Samsung, and Toshiba, to use the chips in infringing modes. (Pl. Exs. 730; 932; 1914; 1915; 1918; 1919).

Likewise, Dr. McLaughlin testified about Marvell field application engineers who are deployed to Marvell's customers to assist them in putting Marvell's chips into their products and instruct them on how to use the chips. (Docket No. 677 at 178-179). To that end, Teik Ee Yeo, Western Digital's corporate designee, testified that the chips it buys from Marvell have the technology enabled, i.e., set to "infringing modes," and that Western Digital tended to follow the suggestions of Marvell engineers regarding these settings on the chips. (Docket No. 761 at Jt. Ex. B 146).⁶⁰ This knowledge of customer use was buttressed by the testimony of CMU industry expert, Dr. Bajorek, who opined that the Accused Technology became industry standard. (Docket No. 678 at 108-112).

Accepting the evidence in the light most favorable to CMU, the nonmoving party, and giving it the advantage of every fair and reasonable inference based on the facts of record, there was sufficient evidence presented at trial to support CMU's theory that Marvell created technology that employed the accused methods with either actual knowledge or willful blindness to the possibility that its devices infringed the patents-in-suit, and that Marvell sold same to its customers. CMU produced sufficient evidence that Marvell actively induced at least one of Marvell's customers to use a method that is covered by Claim 4 of the '839 Patent or Claim 2 of the '180 Patent. Thus, Defendants' JMOL on this issue was denied, and the question of whether

⁶⁰ As noted, two representatives from Western Digital testified at trial, corporate designee Teik Ee Yeo, (Docket No. 761 at Jt. Ex. B), and Iftiqar Baqai. (Docket No. 711). From 1997 to 2005, Mr. Baqai worked at Western Digital in selection and development of read channel chips and their subsequent integration. (Docket No. 711 at 145-147). His testimony did not touch on the enablement of the chips in certain modes. (*Id.*). After 2005, he no longer worked in the read channel area at Western Digital. (*Id.* at 175).

there was induced infringement properly proceeded to the jury. Considering the record as a whole, the jury's verdict of induced infringement is not against the weight of evidence, and the motion for a new trial on this issue is denied.

b. Contributory Infringement

Marvell argues that it was entitled to either a judgment as a matter of law or a new trial on CMU's claims of contributory infringement for actively contributing to infringement. (Docket Nos. 743; 805). It argues that CMU has not proven: (1) direct infringement; (2) that Marvell possessed the requisite intent for contributory infringement, i.e., that it knew the Accused Chips were infringing on CMU's patents; and (3) that Marvell's components had no substantial non-infringing uses. (Docket No. 743 at 3-4).

As previously stated, however, the record shows that CMU put forth ample evidence to prove direct infringement by Marvell's customers, thereby allowing CMU to advance a theory of induced infringement.⁶¹ The Court has also observed that CMU presented sufficient evidence to show that Marvell possessed the requisite knowledge of the patents-in-suit at the time of infringement. (Pl. Ex. 280; Pl. Ex. 283)

Moving forward, the Court finds that CMU has produced sufficient evidence that the Accused Chips were made specifically to use the Accused Technology with no other non-infringing use. For example, Dr. Bajorek testified that all the chips are designed through the described sales cycle and that the final chips are custom made for each customer, with the Accused Technology specifications in mind. (Docket No. 678 at 70). Each customer then received programming instructions to use the chips in infringing modes. (Pl. Ex. 730; Pl. Ex. 1913). Dr. McLaughlin also testified that the MNP and NLD chips do not have any use besides

⁶¹ See discussion *supra* at Section V.A.2.

detecting data in hard drive disks and that they do not have any substantial uses beyond the enabled, infringing modes. (Docket No. 677 at 188).

Accepting the evidence in the light most favorable to Plaintiff, the nonmoving party, and giving it the advantage of every fair and reasonable inference based on the undisputed facts, it is clear that there was sufficient evidence upon which a reasonable jury could properly find that Marvell contributorily infringed Claim 4 of the '839 Patent and/or Claim 2 of the '180 Patent. Accordingly, Marvell's JMOL as to this issue was denied, and the question of whether there was contributory infringement was properly presented to the jury. The jury's finding that Marvell had engaged in contributory infringement was not against the weight of the evidence, and the Court likewise denies Marvell's motion for a new trial on these grounds.

B. Validity

The parties filed cross-motions for JMOL on the patents' validity. The Court was initially presented with CMU's Motion for Judgment As a Matter of Law on Marvell's Invalidity Defenses" as well as its "Brief in Support of its Motion. (Docket Nos. 731; 732). Marvell opposed this motion. (Docket No. 749). Marvell, in turn, submitted its own Motion for Judgment as a Matter of Law on Invalidity with a supporting brief. (Docket Nos. 747; 748). CMU similarly opposed this cross-motion. (Docket No. 750). The Court denied both of these Motions on the record. (Docket No. 759). Following trial, Marvell renewed its JMOL on invalidity and requests, in the alternative, a new trial. (Docket No. 805). CMU did not renew its JMOL on validity given the jury's favorable verdict. (Docket No. 762).

1. Legal Standard

a. Anticipation Legal Standard

An issued patent enjoys a presumption of validity. *See* 35 U.S.C. § 282; *SRAM Corp. v. AD-II Engineering, Inc.*, 465 F.3d 1351, 1357 (Fed. Cir. 2006). Due to this presumption, invalidity must be proven by clear and convincing evidence. *Microsoft Corp. v. i4i Ltd. Partnership* (hereinafter “*i4i*”), ___ U.S. ___, 131 S. Ct. 2238, 2242 (2011). “The burden of establishing invalidity of a patent or any claim thereof shall rest on the party asserting such invalidity.” 35 U.S.C. 282. Even in instances where the allegedly anticipatory reference was not before the Patent and Trademark Office (“PTO”), the clear and convincing standard remains. *See i4i*, 131 S. Ct. at 2244; *see also Uniroyal, Inc. v. Rudkin-Wiley Corp.*, 837 F.2d 1044, 1050 (Fed. Cir. 1988). Given that “[c]redibility determinations, the weighing of evidence, and the drawing of legitimate inferences from the facts are jury functions, not those of a judge,” this Court should not, at this late stage, consider the possible additional weight carried by a piece of prior art not considered by the PTO. *Reeves v. Sanderson Plumbing Prods., Inc.*, 530 U.S. 133, 150 (2000) (citations omitted).

A patent claim is “invalid for anticipation if a single prior art reference discloses each and every limitation” of the claim. *Schering Corp. v. Geneva Pharm.*, 339 F.3d 1373, 1377 (Fed. Cir. 2003) (emphasis added); *see also Zenith Elecs. Corp. v. PDI Commc’ns Sys., Inc.*, 522 F.3d 1348, 1363 (Fed. Cir. 2008). Each element, and the “arrangement or combination” of those elements, must be present in the prior art reference. *See Net MoneyIN, Inc. v. VeriSign, Inc.*, 545 F.3d 1359, 1371 (Fed. Cir. 2008). The key is that, within “the four corners of a single, prior art document ... every element of the claimed invention [must be described], either expressly or inherently, such that a person of ordinary skill in the art could practice the invention without

undue experimentation.” *Advanced Display Sys., Inc. v. Kent State Univ.*, 212 F.3d 1272, 1282 (Fed. Cir. 2000).

b. Obviousness Legal Standard

Obviousness under 35 U.S.C. § 103(a) is a legal question based on underlying factual determinations. *Unigene Labs., Inc. v. Apotex, Inc.*, 655 F.3d 1352, 1360 (Fed. Cir. 2011), *cert. denied*, 132 S. Ct. 1755 (2012). An obviousness analysis measures the difference between the claimed invention and the prior art to determine whether “the subject matter as a whole would have been obvious at the time the invention was made” to a person having ordinary skill in the art. *Alza Corp. v. Mylan Labs., Inc.*, 464 F.3d 1286, 1289 (Fed. Cir. 2006) (citations omitted).

The factual underpinnings of the obviousness analysis, often referred to as the *Graham* factors, include: 1) the scope and content of the prior art; 2) the level of ordinary skill in the art; 3) the differences between the claimed invention and the prior art; and 4) evidence of secondary factors, also known as objective indicia of non-obviousness. *Graham v. John Deere Co.*, 383 U.S. 1, 17-18 (1966). “Evidence rising out of the so-called ‘secondary considerations’ must always, when present, be considered en route to a determination of obviousness.” *Transocean Offshore Deepwater Drilling, Inc. v. Maersk Drilling USA, Inc.*, 699 F.3d 1340, 1349 (Fed. Cir. 2012).

Obviousness requires more than a mere showing that the prior art includes separate references covering each limitation in a claim under examination. *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 418 (2007). Rather, obviousness requires the additional component that a person of ordinary skill at the time of the invention would have selected and combined those prior art elements in the normal course of research and development to yield the claimed invention. *Id.* at 421.

As the parties alleging invalidity of the patents at issue, Marvell was required to prove its invalidity defenses by clear and convincing evidence. *i4i*, 131 S. Ct. at 2242. At trial, Marvell called Dr. John Proakis to provide expert technical testimony. (Docket No. 726). In rebuttal, CMU recalled Dr. Steven McLaughlin to provide expert technical testimony about CMU's patents and the prior art in this field. (Docket No. 736).

2. CMU's Motion on Marvell's Invalidity Defenses

While not raised post-trial, the Court will first address CMU's earlier Motion for Judgment as a Matter of Law on Marvell's Invalidity Defenses (Docket No. 731), which was denied on the record on December 21, 2012 without further exposition given the time constraints of trial. (Docket No. 764 at 99).

a. Anticipation

CMU moved for judgment as a matter of law, asserting that Marvell had failed to put forth sufficient evidence on its invalidity defense of anticipation because: (1) Dr. Proakis admitted that the Worstell Patent does not disclose all elements of the CMU Patents; and (2) Dr. Proakis relied upon an incorrect claim construction making his opinion both incorrect and inadmissible, as a new opinion not disclosed in his expert report. (Docket No. 732).

Marvell had presented Dr. Proakis's testimony to show that all of the elements of the claims-in suit were found in prior art. At the outset, Dr. Proakis opined that the Weining Zeng and Inkyu Lee articles, as well as Dr. McLaughlin's statements on same, proved that Dr. Kavcic and Dr. Moura were not the first to disclose a method selecting a branch metric function from a set of functions for each of the branches at a certain time index. (Def. Exs. 37; 38). Dr. Proakis continued explaining that one of the equations in the '839 Patent expressing the same equation as

Weining Zeng, was, in fact, a set of functions and referenced Dr. Moura's testimony.⁶² (Docket No. 726 at 57). Dr. Proakis also stated that Dr. Kavcic was not the first person to propose a Viterbi detector that took correlated noise into account and recounted that Dr. McLaughlin had said the same thing at his deposition. (*Id.* at 58).

Next, Marvell proffered U.S. Patent No. 6,282,251 (the "Worstell Patent") as prior art for purposes of its anticipation defense. (Def. Ex. 187). This patent was filed on March 21, 1995, three years before the CMU Patents were filed. (*Id.*). Dr. Proakis stated that equation 20 of the Worstell Patent took into account signal dependent noise by scaling the branch metrics that have a signal dependent noise with a fraction that depends on the transition noise standard deviation. (Docket No. 726 at 60). He stated that because transition noise is another term for signal dependent noise, Worstell teaches that whenever there is a transition, the corresponding branch metric function is scaled by one over sigma squared, as disclosed by Inkyu Lee and Weining Zeng. (*Id.*). Dr. Proakis also said that the Worstell Patent disclosed a modified Viterbi detector which accounts for correlated noise, claimed by the first element of Claim 4 of the '839 Patent. (Docket No. 726 at 63). Dr. Proakis then opined that the selecting and applying limitations of the '839 Patent are found in the Worstell Patent by highlighting the parts of relevant equations derived from the Worstell Patent and the corresponding elements of Claim 4. (*Id.* at 68). Marvell

⁶² Dr. Moura's referenced deposition testimony is as follows:

Q: Okay. So, in your mind, branch metric equation 10 at the bottom of column 6 of the '180 Patent is a set of branch metric functions; is that correct?

A: I guess we could say so.

Q: Why?

A: I told you, because the variance depends on the AIs, signal dependent.

(D Demo 12-10).

supported its position with proffered deposition testimony from Dr. McLaughlin.⁶³ Thus, Dr. Proakis concluded that Claim 4 of the '839 Patent was anticipated by the Worstell Patent.

Dr. Proakis then moved to Claim 2 of the '180 Patent, and as four of the elements were previously determined to be present in the Worstell Patent through his '839 analysis, he discussed the receiving step of Claim 2. (Docket No. 726 at 68-71). Dr. Proakis highlighted the relevant portions of the Worstell Patent and stated that the Worstell branch metric equation covers both correlated noise and signal dependent noise. (*Id.*). With this, Dr. Proakis concluded that Claim 2 of the '180 Patent was anticipated by the Worstell Patent. (*Id.*).

CMU countered that Dr. Proakis' opinions rested on an incorrect claim construction of the terms "function" and "signal dependent branch metric function" and that such contradictory testimony is therefore insufficient for a finding of validity as a matter of law. (Docket No. 732). Having considered his testimony, the Court held that the record was not entirely clear that Dr. Proakis offered a contradictory construction at trial, thereby violating the expert disclosure requirements of Rule 26. (Docket No. 726 at 110-111); *see Pritchard v. Dow Agro Scis*, 263 F.R.D. 277, 284-85 (W.D. Pa. 2009) ("[c]ase law establishes that a declaration should be stricken if it contains new opinions or information which is contradictory to that set forth in the expert report, but it need not be stricken if it contains merely an elaboration of and is consistent with an

⁶³ Dr. McLaughlin testified:

Q: The paragraph refers to a further modified metric at Line 49 and Column 10; right?

A: Okay. Yes.

Q: And you agree that the paragraph describes modifying a metric to take transition noise into account?

A: That is what -- that is what the sentence says.

Q: And you agree that the transition noise can depend on the type of the transition; is that correct?

A: The noise -- the value of the noise is going to be different -- is going to be different whether there is a transition or whether there is no transition.

(D Demo 12-16).

opinion/issue previously addressed in the expert report”). While the Court has clarified the legal meaning of certain terms for this case, Dr. Proakis’ use of the challenged terms throughout his long career has not been guided by this Court’s claim construction. Similarly, his prior use of the word “function” came before the Court offered clarification as to the meaning of this term for this case. (Docket No. 337).⁶⁴ To find that he has changed his entire opinion based on these statements alone is an unwarranted conclusion for the Court to make. Even if Dr. Proakis had offered a “new opinion” for the first time at trial, the striking of such evidence for a discovery violation is an “extreme sanction” normally reserved for a “showing of willful deception or ‘flagrant disregard’ of a court order by the proponent of evidence,” which is not the case here. *Konstantopoulos v. Westvaco Corp.*, 112 F.3d 710, 719 (3d Cir. 1997) (quoting *Meyers v. Pennypack Woods Home Ownership Ass’n*, 559 F.2d 894, 905 (3d Cir. 1977)).

To the extent that CMU continues to claim that Dr. Proakis used the incorrect meaning of the term “signal dependent branch metric function,” its argument seems to be one of semantics and not an issue of law upon which the Court need rule. Throughout the trial of this case, the jury had the Court’s claim constructions,⁶⁵ and counsel as well as witnesses displayed portions in parts of their slides. (Docket No. 770 at Ex. M; Docket No. 771 at Ex. H). Any alleged discrepancies between his use of the term “signal dependent branch metric function” in his expert report and trial testimony were addressed during cross-examination, and, as such, went towards the ultimate weight of his opinion, as determined by the jury. *See i4i Ltd. P’ship v.*

⁶⁴ The Court is also mindful in June 2012, after its decision on the construction of the term “function,” the Court denied Marvell’s Motion for Leave to Supplement Expert Reports to Take Into Account the Court’s Summary Judgment Ruling. (Docket No. 425). In so holding, the Court noted that expert discovery was to have been completed by April 6, 2012, (Docket No. 315), and that as Marvell had been aware of CMU’s position “well before its expert reports were due, [] it should have anticipated the possibility that the Court would adopt CMU’s position.” (Docket No. 425).

⁶⁵ Each of the jurors had a notebook throughout trial that contained a copy of the patents, claims construction, and a glossary of useful terms.

Microsoft Corp., 598 F.3d 831, 856 (Fed. Cir. 2010) (“[v]igorous cross-examination, presentation of contrary evidence, and careful instruction on the burden of proof are the traditional and appropriate means of attacking shaky but admissible evidence.”) (citing *Daubert v. Merrell Dow Pharm., Inc.*, 509 U.S. 579, 596 (1993)).

CMU claims that during cross-examination, Dr. Proakis admitted that the Worstell Patent did not disclose all elements of the CMU Patents. (Docket No. 732). Dr. Proakis stated that the Worstell Patent spoke of “zero” branches and “one” branches. (Docket No. 726 at 92-94). During cross, he agreed that the Worstell Patent never put any multiplier on the “zero” branches but stated it would be “totally obvious to a person skilled in the art.” (Docket No. 726 at 94). The key to anticipation is that every element of the claimed invention must be described in the piece of prior art. *Advanced Display Sys., Inc.*, 212 F.3d at 1282. However, the prior art can describe the elements inherently, such that a person of ordinary skill in the art could still practice the invention without undue experimentation. *Advanced Display Sys., Inc.*, 212 F.3d at 1282.

The Court is mindful that Dr. Proakis is a technical expert, not a legal expert, and his statement, as CMU interprets it, is not dispositive on its own. Resolving all reasonable inferences in favor of the non-movant, the Court determined that a jury could find that his statement that the multiplier would be “totally obvious to a person skilled in the art” was made to show that the prior art inherently described the claimed invention. (Docket No. 726 at 94). Whether his position is credible is the province of the jury. *Collins v. Signetics Corp.*, 605 F.2d 110, 115 (3d Cir. 1979) (“Neither a trial nor an appellate court has the authority to substitute its judgment for that of the jury and thus usurp the jury’s function as the principal finder of fact.”). Given the stage of trial, the Court did not find Dr. Proakis’s statement to be an admission that the Worstell Patent does not anticipate the patents-in-suit as a matter of law. The Court reiterates that the

making of credibility determinations, weighing of evidence, and the drawing of reasonable inferences from the facts are jury functions—they are not to be usurped by the Court as a matter of law. *Eschelman*, 554 F.3d at 433.

Having considered the evidence in the light most favorable to the nonmoving party, Marvell, and giving it the advantage of every fair and reasonable inference in light of the undisputed facts, this Court concluded that Marvell had presented enough evidence for a reasonable jury to find that Claim 4 of the ‘839 Patent and Claim 2 of the ‘180 Patent were anticipated. Therefore, CMU’s motion for judgment as a matter of law on this basis was denied, and the question of whether there was invalidity by anticipation was presented to the jury.

b. Obviousness

CMU argued that it was entitled to judgment as a matter of law on invalidity because Marvell had failed to provide sufficient evidence that the asserted claims were obvious because: (1) Dr. Proakis again admitted that the Worstell Patent does not disclose all elements of the CMU Patents; (2) Dr. Proakis once more relied upon an incorrect claim construction making his opinion both incorrect and inadmissible, as a new opinion not disclosed in his expert report;⁶⁶ and (3) Dr. Proakis’s opinion was simply conclusory. (Docket No. 732).

Dr. Proakis opined that even if the Worstell Patent did not anticipate the asserted claims, the Worstell Patent proves that the claims would have been obvious to a person of ordinary skill in the art. (Docket No. 726 at 94). He stated that he believed a person of ordinary skill in the art, reading the Worstell Patent claims and Column 10, would know that sigma squared has to vary from branch to branch. (*Id.*). This, he urged, would make Claim 2 of the ‘180 Patent and Claim 4 of the ‘839 Patent obvious to a person of ordinary skill in the art. (Docket No. 726 at 77). His

⁶⁶ The Court has just addressed CMU’s arguments on the admissibility of Dr. Proakis’s “new” opinion and need not address the issue again. *See* discussion *supra* at Section V.B.2.a.

analysis was based primarily on his examination of the Worstell Patent. However, Marvell had provided enough evidence to show that Dr. Proakis's testimony was not conclusory and that he considered secondary indicia of non-obviousness, such as statements by Dr. McLaughlin, Dr. Moura, and Dr. Kavcic regarding the novelty of aspects of their invention. (Docket No. 726 at 58-59).

He and Dr. McLaughlin disputed what a person of the ordinary skill in the art would find to be obvious and the nature of secondary considerations. (Docket No. 726 at 75-77; Docket No. 736 at 80-81). To this end, Dr. Proakis stated the reasons for his view (Docket No. 726 at 75-77), and the Court does not find that they were conclusory as a matter of law. Obviousness, in the end, is a question that must be determined based on the weight of the evidence presented and on credibility determinations. *See Unigene*, 655 F.3d at 1360.

After considering the evidence in the light most favorable to the nonmoving party, Marvell, and giving it the advantage of every fair and reasonable inference in light of the undisputed facts, the Court concluded at trial that Marvell had presented enough evidence for a reasonable jury to find that Claim 4 of the '839 Patent and Claim 2 of the '180 Patent were obvious. Therefore, CMU's motion for judgment as a matter of law on this basis was denied, and the question of invalidity by obviousness was properly given to the jury to decide.

c. Written Description, Indefiniteness, and Enablement

At trial, CMU contended that Marvell had adduced no evidence in support of its written description, indefiniteness, and enablement defenses. Marvell acknowledges such in its Brief in Opposition, stating "Marvell acknowledges that it has not pursued its Section 112 defenses (written description, enablement, and indefiniteness) at trial." (Docket No. 749). Accordingly, these defenses are waived. Moreover, as there was no evidence presented on Marvell's invalidity

defenses of written description, indefiniteness, and enablement, no reasonable jury could properly find a verdict in favor of Marvell on these defenses. (Docket No. 726). Therefore, CMU's motion for judgment as a matter of law on these three defenses was denied as moot. (Docket No. 764 at 99).

3. Marvell's Motion for Invalidity

a. Anticipation

Marvell argues that it is entitled to judgment as a matter of law or, in the alternative, a new trial on the issue of invalidity by anticipation because: (1) the PTO did not consider the Worstell Patent (Def. Ex. 187); (2) the Worstell Patent discloses every limitation of Claim 4 of the '839 Patent; and (3) that Worstell discloses every limitation of Claim 2 of the '180 Patent. (Docket Nos. 748; 805).

On the first point, Marvell has given the Court no authority as to why the fact that the Worstell Patent was not disclosed to the Patent Office is relevant to the JMOL anticipation analysis. Marvell argues that such a circumstance may ease the burden of clear and convincing evidence (Docket No. 748 at 2); yet, the Court is mindful that the jury is tasked with weighing the evidence. *Eschelman*, 554 F.3d at 433. The fact that the allegedly anticipatory reference was not before the PTO does not change the clear and convincing standard for invalidity defenses, and it is therefore irrelevant to the Court's decision on anticipation. *i4i*, 131 S. Ct. at 2244. Despite same, the jury was free to consider this fact in its determination on invalidity.⁶⁷

⁶⁷ The jury as the fact finder is tasked also with determining expert credibility. *Miller*, 2011 WL 7037127, at *3 n.3. The Court notes several factors that could have had an impact on the jury's analysis of the facts, including length of the testimony, demonstratives, the thoroughness of presentation, and ease of understanding the expert's testimony, all of which, in the Court's estimation, weighed in CMU's favor throughout the trial. For each of his conclusions, Dr. McLaughlin methodically laid out his opinions, cited the underlying factual support, explained his reasoning with drawings and demonstratives, and then reiterated his opinion again. (Docket No. 677). His approach was extremely thorough, complete, and clear. Dr. Blahut and Dr. Proakis, on the other hand, were forced to testify in a hurried, sometimes disjointed fashion due to the time spent on other witnesses by Marvell's trial team.

At trial, CMU called Dr. McLaughlin, as a rebuttal validity expert, to show that the Worstell Patent did not invalidate the asserted claims. Dr. McLaughlin first testified that CMU's patents were novel in that they claimed a method using a set of signal dependent branch metric functions and applied those signal dependent branch metric functions to a plurality of signal samples. (Docket No. 736 at 54). Dr. McLaughlin contrasted the CMU Patents from the Inkyu Lee and Weining Zeng articles by explaining that those articles referred to a single signal sample, directed just towards transition noise, while CMU's invention is oriented towards multiple signal samples and intended to address noise associated with a specified sequence of symbols, not just one transition. (*Id.* at 54).

In regards to the Worstell Patent, Dr. McLaughlin stated that both Claim 4 of the '839 Patent and Claim 2 of the '180 Patent require a set of signal-dependent branch metric functions while the Worstell Patent only contemplates one. (*Id.* at 55). Dr. McLaughlin explained that Equation 20 of the Worstell Patent shows just this single FIR filter. (*Id.* at 65). Given Dr. Kavcic's prior testimony and related demonstratives, Dr. McLaughlin showed how Dr. Kavcic had originally only contemplated one FIR filter, which was the same as the Worstell Patent invention, but then moved on from this idea to develop the invention in suit. (*Id.* at 64). Next, Dr. McLaughlin opined that Worstell's patent takes transition noise into account by modifying the branch metrics by a fraction, but that this modification only happens on the "one" branches, not the "zero" branches, and thus not on all branches. (*Id.* at 67). He further explained that the fraction is a constant for all the branches, meaning that the method taught in the Worstell Patent is different from that discussed in the patents-in-suit, where that modification is variable. (*Id.* at

Unsurprisingly, they were not able to elucidate their opinions as clearly as Dr. McLaughlin, who was by far the best of the technical witnesses. (Docket Nos. 711; 726).

67-68). Finally, Dr. McLaughlin concluded that the Worstell Patent did not apply the transition noise adjustment to a plurality of signal samples. (*Id.* at 70).

Dr. McLaughlin disagreed with Dr. Proakis's opinions on invalidity, considering them to be incorrect. (*Id.*) Instead, he testified that Dr. Proakis had described the Worstell method in the opposite order of how the patent described it and referred to a further modified branch metric equation that did not appear in the Worstell Patent. (*Id.* at 67-68). Given all of this, Dr. McLaughlin stated that the Worstell Patent did not contain each of the elements of Claim 4 of the '839 Patent or each of the elements of Claim 2 of the '180 Patent. (*Id.* at 73) In his opinion, the asserted claims of the '839 Patent and the '180 Patent were not anticipated. (*Id.*).

The factual disputes regarding invalidity that underlie the experts' opinions in this case were for the jury to decide. *See In re Montgomery*, 677 F.3d 1375, 1379 (Fed. Cir. 2012), *cert. denied*, 133 S. Ct. 788 (2012). Once again, Dr. McLaughlin's conclusions were left to the jury to accept or reject as it was for them to determine credibility and the weight given to such evidence. *Id.* Considering the evidence in the light most favorable to the nonmoving party CMU, and giving it the advantage of every fair and reasonable inference in light of the undisputed facts, the Court concluded that CMU had presented enough evidence upon which a reasonable jury could properly find that Claim 4 of the '839 Patent and Claim 2 of the '180 Patent were not anticipated. Therefore, Defendants' motion for JMOL on the basis of invalidity is denied. Similarly, the jury's finding that the patents were not invalidated due to anticipation is not against the weight of the evidence, and Marvell's motion for a new trial on these grounds is thus denied.

b. Obviousness

Marvell further contends that it is entitled to judgment as a matter of law or a new trial on the issue of invalidity because the asserted claims are obvious. To prove otherwise, once again,

CMU proffered the testimony of its expert, Dr. McLaughlin. In his analysis, Dr. McLaughlin considered all of the pieces of prior art that Dr. Proakis relied upon in his opinion of invalidity, such as the Inkyu Lee and Weining Zeng articles, as well as the Worstell Patent, in addition to other pieces of prior art that Dr. Proakis did not discuss. (Docket Nos. 726; 737). Dr. McLaughlin then concluded that the asserted claims were not obvious. (Docket No. 737 at 73).

Dr. McLaughlin also considered the secondary indicia of non-obviousness presented throughout the trial such as praise for the invention by the industry in general and by Marvell employees and the fact that the invention solved a long-perceived problem. (*Id.* at 71-72).⁶⁸ Additionally, CMU and Dr. McLaughlin proffered an email from Glen Worstell as secondary indicia of non-obviousness. (Pl. Ex. 161). In his email, Dr. Worstell wrote that the Kavcic/Moura invention “is related but goes beyond my work and is probably more interesting.” (*Id.*).

Based on his analysis, the factors of non-obviousness, and his knowledge of the field, Dr. McLaughlin concluded that neither Claim 4 of the ‘839 Patent nor Claim 2 of the ‘180 Patent were obvious to a person of ordinary skill in the art. (Docket No. 736 at 73). Given Dr. McLaughlin’s opinion and the underlying factual predicates, the Court found that the question of obviousness was rightly sent to the jury to resolve. *See Walker*, 46 F. App’x at 695; *Miller*, 2011 WL 7037127, at *3 n.3. Considering the evidence in the light most favorable to the nonmoving party, CMU, and giving it the advantage of every fair and reasonable inference in light of the undisputed facts, the Court found that CMU had sufficiently presented enough evidence upon which a reasonable jury could properly find that Claim 4 of the ‘839 Patent and Claim 2 of the ‘180 Patent were not obvious. Therefore, Marvell’s motion for judgment as a matter of law on this issue was denied. The question of invalidity by obviousness was properly decided by the

⁶⁸ While, Dr. McLaughlin explicitly listed examples of indicia to show non-obviousness, (Docket No. 737 at 71-72), Dr. Proakis did not rebut Dr. McLaughlin’s considerations on this indicia or provide any contrary evidence. (Docket No. 726).

jury, which found that the patents were not rendered invalid for being obvious. (Docket No. 762). Considering the evidence proffered by CMU, this verdict was not against the clear weight of the evidence and a new trial is not warranted as to this defense.

C. Willfulness

The Court turns to CMU's claims of willfulness. At trial, Marvell filed a Motion for Judgment as a Matter of Law on Willful Infringement and a Renewed Motion for Judgment as a Matter of Law on Willful Infringement (Docket No. 740), both of which were fully briefed. (Docket No. 700, 721, 740, 741). The Court denied these motions on the record, following arguments by counsel, letting the relevant issues of willfulness go to the jury. (Docket No. 759 at 52-53).

After trial, CMU filed a Motion for a Finding of Willful Infringement and Enhanced Damages. (Docket No. 790). Marvell also filed a Motion for Judgment as Matter of Law, or in the Alternative, New Trial on Non-Damages Issues, wherein it requests a JMOL or new trial on the issue of willfulness. (Docket No. 805).

The Court will now address the specific matters raised by these motions, considering all of the parties' arguments and the entire trial record, to explain its earlier and current decision.

1. Legal Standard

It is undisputed that CMU must establish willful infringement by proving, with clear and convincing evidence that (1) Marvell acted despite an objectively high likelihood that its actions constituted infringement of a valid patent, and (2) that this objectively-defined risk of infringement was either known or so obvious that it should have been known to the accused infringer. *Bard Peripheral Vascular Inc. v. W.L. Gore & Assocs., Inc.*, 682 F.3d 1003, 1005 (Fed. Cir. 2012), *cert. denied*, 133 S. Ct. 932 (2013); *In re Seagate Tech. LLC*, 497 F.3d 1360,

1371 (Fed. Cir. 2007) (en banc). The Court’s determination should be “based on the record ultimately made in the infringement proceedings.” *Bard*, 682 F.3d at 1008.

a. Objective Reasonableness

Marvell first argues that CMU has not proven objective unreasonableness. (Docket No. 700 at 6, Docket No. 741 at 7). To the contrary, the Court believes CMU has presented sufficient evidence to conclude that Marvell’s actions were such that a reasonable person would have considered there to be a high likelihood that infringement of CMU’s patents would result.

i. Marvell’s Knowledge of the Patents and Awareness of an Objectively High Likelihood of Infringement

The evidence at trial clearly and convincingly shows that Marvell had knowledge of the patents-in-suit at the time of infringement by 2002 and that the very people who designed the Accused Technology knew of the patents. To the extent a question of fact remained, the jury found as part of its December 26, 2012 verdict that Marvell had “actual knowledge of the ‘180 and ‘839 Patent prior to commencement of this lawsuit (in other words, prior to March 6, 2009).” (Docket No. 762 at 6-7). This jury determination is supported by substantial evidence.

Marvell first should have been aware of Kavcic’s work through an email on March 8, 1998 from Aleksandar Kavcic to Nersi Nazari at Marvell, in which Dr. Kavcic inquired about Marvell’s detectors and sought information about the possibility of getting a job at Marvell. (Def. Ex. 1023). In that email, Kavcic states that he had sent Dr. Nazari his Globecom paper and referred Dr. Nazari to his other publications online. (*Id.*) This Globecom Paper addresses some of the ideas expressed in the patents, but it is not the IEEE paper later referenced by Burd.⁶⁹

⁶⁹ On these facts the Court believes the jury could have made a number of legitimate inferences, including the possible conclusion Dr. Nazari may have shared Dr. Kavcic’s work with Marvell’s team. The jury was instructed that :

(Docket No. 674 at 118). In sending this email, Dr. Kavcic did not grant Marvell any rights to use the ideas in the paper.⁷⁰ (*Id.*). The response to this email was not proffered at trial, and Dr. Nazari did not testify at trial.⁷¹

Next, Marvell engineer Gregory Burd, the developer of the Accused Technology, stated that he read Dr. Kavcic's published papers and learned about his Viterbi detector. (Docket No. 726 at 137). He told his supervisor, Toai Doan, about his work on "Kavcic's model" in 2001, (Docket No. 677 at 53:14-54:17; Pl. Ex. 227), and stated he was able to develop a sub-optimal media noise detector based on the Kavcic model from Kavcic's IEEE Paper. (Pl. Ex. 279). Mr. Burd then informed his superiors twice via email about the CMU Patents in January 2002. (Pl. Ex. 280; Docket No. 677 at 73:13-74:11; Pl. Ex. 283) ("And of course as I mentioned earlier, Kavcic detector is also patented."). Mr. Burd testified that he used Dr. Kavcic's model to create a simulation program at Marvell. (Docket No. 726 at 137) ("Q. Did you or someone else at Marvell create a simulation in the computer of what Professor Kavcic was describing? A. Yes, I did."). Mr. Burd named his model KavcicPP, and he named his optimal simulator KavcicViterbi.

While you may consider only the evidence in the case in arriving at your verdict, you are permitted to draw such reasonable inferences from the testimony and the exhibits you feel are justified in light of your own common experience, reason, and common sense.

(Docket No. 764 at 55).

⁷⁰ At trial Dr. Kavcic was asked,

Q: And you understood if you sent the paper to Marvell, they were free to use the information that was in the paper in their business. Right?

Kavcic: No, sir. No. No, not. Because this was already filed for a patent, and nobody is free to use something that is without a license if it's filed and then ultimately patented.

Q: And --

Kavcic: But I was sending this to Dr. Nersi Nazari because I wanted him to know what I was working on as a lead-in to providing me an interview, because I was looking for a job.

(Docket No. 674 at 118-119).

⁷¹ See *supra* note 21.

In 2003, the KavcicPP was renamed to MNP. (Pl. Ex. 368). Both Dr. Wu and Mr. Doan, who were engineers at Marvell at that time, testified that they became aware of the patents in early 2002 when applying for Marvell's patent related to MNP technology, when they listed CMU's patents as prior art. (Docket No. 707 at 322; Docket No. 761 at Jt. Ex. D at 124:22-125:19; U.S. Patent No. 6,931,585). Yet, all three claimed they had not read the patents at the time. (*Id.*).

In addition to internal notification on the patents, CMU also sent two letters to Marvell's CTO Dr. Pantas Sutardja and Matthew Gloss, then General Counsel, enclosing copies of the patents and inquiring if there was an interest in the patents. (Pl. Ex. 422; Pl. Ex. 431). Marvell did not respond to these letters because, as CEO Dr. Sehat Sutardja alleges, they were "not interested in using the technology in our chip." (Docket No. 707 at 91). In addition, Fujitsu, "a customer of Marvell's read channel i.e. 5575M, 7500M," wrote to Marvell in November 2004, that it had received a license offer for the CMU Patents-in suit. (Pl. Ex. 477). Fujitsu wrote that "since it seems that these patents might be related to read channel, we would like to know, by the end of November, your opinion regarding relationship between CMU's Patents and the above Marvell lead [*sic*] channel and the specific grounds/reasons for such opinion." (*Id.*). No documents were found in relation to this letter, and Marvell's corporate designee testified that he did not know of any response to this letter. (Docket No. 761 at Jt. Ex. C at 534-535).

Despite knowing about the patents-in-suit, the evidence presented at trial reveals that Marvell made little effort to determine whether it was infringing these patents. Dr. Wu, Mr. Burd, and Mr. Doan all state that they decided not to read the patent claims, even though email correspondence indicates that both were aware that Dr. Kavcic had patented his algorithm. (Pl. Ex. 280; Pl. Ex. 283). If believed, this behavior is a clear sign they disregarded a high likelihood of infringement. Once presented with the patents, Mr. Doan did not conduct further

investigations on his own, tell others to investigate or send the patents to Marvell's legal team.⁷² (Docket No. 761 at Jt. Ex. C at 125-130). Instead, he directed his employees to continue working to capture the realized gain and reported that his employees would continue to work on the "Kavcic model." (*Id.* at Ex. D at 190-191; Pl. Ex. 285). This occurred around the time that he was promoted from his position as principal engineer of the signal processing group to Vice President of read channel development. (Docket No. 761 at Jt. Ex. C at 16-17). While Marvell alleges that the MNP is a suboptimal version of Dr. Kavcic's work, Dr. Wu's 2003 email to Doan stated that he and Burd were implementing an approach that "turns out to be the original structure that Kavcic proposed in his paper." (Pl. Ex. 366; Docket No. 677 at 134-135).

These failed opportunities to investigate engendered a great deal of risk that Marvell's engineers infringed CMU's patents. Moreover, the lack of action by Marvell's employees does not conform to Marvell's own purported IP policy, which according to the testimony of Dr. Armstrong, Marvell's Vice President of Marketing, requires that any such information about patents be forwarded to the legal department for analysis. (Docket No. 761 at Jt. Ex. C at 294-295). Despite this, Dr. Armstrong stated that he did not know whether the CMU Patents were ever submitted to the legal department according to this policy. (*Id.* at 295, 299). He further testified that he was not aware of any internal discussion about licensing the patents from CMU given Fujitsu's letter request. (*Id.*).

Marvell's lack of inquiry about the possibility of infringement also meant that it took no effort to avoid infringement of the subject patents. This fact was specifically corroborated by Mr. Burd, who stated that he was not aware of any measures being taken to stop using the CMU Patents. (Docket No. 678 at 101). Marvell is a sophisticated entity with nearly 3,000 patents.

⁷² Mr. Doan testified by way of deposition designations. (Docket No. 761 at Jt. Ex. C). Mr. Doan left Marvell in October of 2009. (*Id.*). As a former employee, he may not have been perceived with any bias towards Marvell, compared to other witnesses who were still current employees. (*Id.*).

(Docket No. 707 at 53). Yet, it took absolutely no steps to investigate these patents before producing 2.3 billion chips, despite the fact that the technology was *named* after Dr. Kavcic, one of the inventors of the CMU Patents.⁷³ To this day, Marvell continues to use the Accused Technology. In fact, at trial Mr. Burd testified that Marvell had no plans to discontinue using the technology. (Docket No. 678 at 101). Only as of July 2013—seven months after the verdict—is it beginning to design around the technology. (Docket Nos. 889; 898).

Succinctly put, Burd presented his superiors at Marvell with a product named “KavcicPP” and noted that Dr. Kavcic held a patent on such a detection scheme, yet nothing was apparently done to investigate infringement, reach out to Dr. Kavcic or CMU, or respond to CMU and Fujitsu’s inquiries on same. Accordingly, CMU has shown that Marvell’s behavior created an objectively high risk of infringement. *See Spectralytics, Inc. v. Cordis Corp.*, 649 F.3d 1336, 1348 (Fed. Cir. 2011) (failure to investigate the patent situation is a consideration that tends to establish willful infringement).

ii. “Reasonable” Defenses

In response to CMU’s claim of willfulness, Marvell urges that the “‘objective’ prong of [willfulness] tends not to be met where an accused infringer relies on a reasonable defense to a charge of infringement.” *Bard.*, 682 F.3d at 1005. Given its stance, the Court will review Marvell’s defenses, how they evolved and were used at trial, if at all.

⁷³ As shown at trial, Mr. Burd stated at his deposition:

Q: And why use the Kavcic approach, as the yardstick?
 A: ...just because his name, kind of became a yardstick. I don’t know why. I mean, people use it. It’s like when you say-you know there are certain people which get associated with – some event.... Ronald Reagan is credited with breaking down the wall. Well, I didn’t see him break any bricks. Right? But yet, he is the one. So same thing.

(Docket No. 771 at Ex. H at 110).

Marvell had several overarching defenses to the willful infringement claim, the first being that Marvell believed its own technology covered the MNP. To this end, Marvell was allowed to present, at trial, patent U.S. Patent Number 6,931,585 (the “‘585 Patent”)⁷⁴ filed in July 2002, with Dr. Wu and Mr. Burd listed as inventors, and which related to MNP technology.⁷⁵ (Def. Ex. 266). These patents may be relevant to the state of mind of the infringer, but infringement is determined by mapping the claims of the patents-in-suit onto the Accused Technology. *See Akamai Techs.*, 692 F.3d at 1307 (“Because patent infringement is a strict liability offense, the nature of the offense is only relevant in determining whether enhanced damages are warranted.”). Marvell argued that since the PTO had granted Marvell the ‘585

⁷⁴ The ‘585 patent is owned by Marvell International Ltd, based in Hamilton, Bermuda. *See* ‘585 Patent. Marvell International Ltd., is not a party to this case, and, as such, CMU argues these patents are irrelevant. (Docket No. 726 at 4). CMU contends that the admission of these patents opened the door to inquiry of Marvell’s corporate structure, such that this patent and hundreds of others offered as exhibits at trial

are owned by Marvell International, Limited as part of the tax structure -- tax favorable structure I’ll call it. So, you know, if they would want to go there with respect to those patents, we ought to be entitled to talk about, you know, why that works and how it works and what’s going on there. The fact that Marvell has to pay royalties to itself -- although, frankly, they did not give us discovery on that issue and so they can’t talk about a number, but, you know, they’ve introduced that patent and want to introduce evidence of about 200 more that are owned by some other entity.

(Docket No. 710 at 4-5). In its order on Marvell’s motion *in limine*, the Court precluded CMU from introducing evidence or argument at trial that Marvell’s tax strategy was illegal or inappropriate. (Docket No. 605). Thus, evidence on this subject was not introduced by the parties during trial.

⁷⁵ The Court reminded the jury throughout the trial that owning one or more patents in and of itself is not a defense against the charge of infringement. The following instruction was taken from the parties’ proposed limiting instructions (Docket No. 625 at Ex. 4), and was repeatedly used during trial:

You have heard testimony about Marvell and whether Marvell does or does not own a patent. Marvell may claim that some of its patents cover some of the accused chips or simulators in this case. It may also claim that it improved on the CMU patents. While this evidence may be relevant to some issues you will decide, owning one or more patents in and of itself is not a defense against the charges of infringement of the CMU patents.

(Docket No. 707 at 90, 294).

Patent, Marvell believed it did not infringe.⁷⁶ The reasonableness of this position, given its factual nature, was left for the jury to decide. *Bard*, 682 F.3d at 1008. Indeed, Marvell’s argument on this point is completely factual, as it has not argued any legal theory to support its defense that its later patents in some way invalidate earlier ones, or that owning a patent on Accused Technology is a *per se* sign of reasonableness and non-infringement. To the extent that this defense is factual in nature, it was presented to the jury, as instructed by *Bard*,⁷⁷ and the jury found that Marvell had no “objectively reasonable defense.” (Docket No. 762). The Court likewise agrees.

A novel and non-obvious after-issued patent may be valid over a prior-issued patent, but that does not mean that, if practiced, the technology disclosed in the after-issued patent would not infringe the prior-issued patent. *Bio-Tech. Gen. Corp. v. Genentech, Inc.*, 80 F.3d 1553, 1559 (Fed. Cir. 1996) (“The existence of one’s own patent does not constitute a defense to infringement of someone else’s patent.”) (internal citation omitted). Therefore, Marvell’s over-reliance on its own patents is misplaced. Rather than focusing on its patents, which have absolutely no bearing on the reasonableness of its defense, the inquiry should center on the Accused Technology and CMU’s patents. Marvell’s assertions that its patents form a valid defense are not at all reasonable, either legally or, according to the jury, factually, as the Court will now explain.

⁷⁶ Of course, a patent issued by the PTO may later be declared invalid. *See* 35 U.S.C. § 282. Indeed, Marvell has sought to invalidate CMU’s patents in this case. (Docket Nos. 747; 748)

⁷⁷ “[T]he judge may when the defense is a question of fact or a mixed question of law and fact allow the jury to determine the underlying facts relevant to the defense.” *Bard*, 682 F.3d at 1008. Trial courts have adopted this practice in similar patent cases. *See, e.g., Grant St. Grp., Inc. v. Realauction.com, LLC*, Civ. No. 09-1407, 2013 WL 2404074, at *4-5 (W.D. Pa. May 31, 2013) (“The Court concludes that there are likely mixed questions of law and fact with regard to Realauction’s defenses, insofar as the jury should be presented the evidence to determine the underlying facts relevant to the defenses before this Court rules on the objective prong of willful infringement”) (internal citations omitted).

To the extent that Dr. Wu has suggested that he consulted with Marvell’s legal counsel about the patent, the Court notes that this testimony is hotly contested, was not significantly developed at trial, and was shrouded by the attorney-client privilege. Dr. Wu testified that the “prior art,” i.e., the ‘180 Patent and the ‘839 Patent, was given to Marvell’s patent counsel and that he later obtained his own patents (owned by a Marvell-entity).⁷⁸ (Docket No. 707 at 323; Docket No. 709 at 90). Marvell, however, has expressly stated throughout this litigation that it is not raising advice of counsel as a defense to the willfulness claims. (Docket No. 174-1 at 77-78). To that end, the Court on December 20, 2012 ruled that Marvell could not at trial – “without putting the actual communications from counsel at issue – argue that its receipt of a patent implies or suggests that Marvell’s counsel returned a favorable opinion that Marvell’s NLD-type and MNP-type chips and simulators and the Kavcic-Viterbi simulator do not practice the patented methods of the asserted claims.” (Docket No. 753). Despite this, Marvell’s counsel attempted to imply at closing that its engineers had vetted this patent with counsel based on snippets of Dr. Wu’s testimony. (Docket No. 759 at 79-80). The Court has doubts about the credibility of certain testimony⁷⁹ regarding this consultation and the reasonableness of this defense, given its years of involvement with this matter.⁸⁰

⁷⁸ CMU contends that Dr. Wu was clear in his deposition that such communications with a lawyer regarding the patents were made only for his prior art search for his own patent filed in 2002. (Docket No. 709 at 91-92).

⁷⁹ As the Court recounted in its opinion on Marvell’s Motion for a Mistrial, (Docket No. 900), Dr. Wu during his testimony clenched his jaw, drank an entire pitcher of water, generally appeared uncomfortable, and continuously looked at Dr. Sutardja in the back of the courtroom throughout his appearance as a witness. In this Court’s estimation, the jury could have easily found Dr. Wu was not credible given his demeanor on the stand. On this and all other areas of inquiry, the jury was charged to weigh witness testimony and give it the appropriate weight it deserved or discredit the testimony completely. *See, e.g., Barber v. CSX Distribution Servs.*, 68 F.3d 694, 700 (3d Cir. 1995).

⁸⁰ Upon consideration of CMU’s “Motion in Limine Strike Testimony and to Preclude Argument Relating to Marvell’s Pre-suit Communications with Counsel about the Patents-in-Suit” (Docket No. 722), the Court ordered Marvell to produce any and all documents that involve or reference Mr. Gregory Burd, Dr. Zining Wu, Eric Janofsky, Esq., CMU, Kavcic, or Seagate between the years of 2001 to 2003, and any and all documents involving Fujitsu between the years of 2003 to 2005 to the Court for an *in camera* review. (Docket No. 737). The Court

Next, Marvell argued that it did not infringe the patents-in-suit in its chips and chip simulators because the patents-in-suit are too “complex.” (Docket No. 741 at 9, 10, 15, 18). This defense does not address Marvell’s KavcicViterbi Simulator, which it acknowledges embodies the “complex” solution of the patents.⁸¹ Marvell claims that even the inventors of the patents admitted that their method was too complex to implement in an actual chip, suggesting that Marvell could not have willfully infringed on a patent with its “simpler, sub-optimal” solutions. (Docket No. 759). But, optimality is not relevant to whether Marvell used a method that includes each and every method step of the asserted claims in the patents-in-suit. *Akamai Techs.*, 692 F.3d at 1307. As Dr. McLaughlin explained at trial, the difference between an optimal and sub-optimal media detector relates to performance as measured by SNR gain rather than infringement. (Pl. Ex. 279; Docket No. 677 at 64-65). In fact, he specifically stated that the sub-optimal detector “would be using the same method” as the optimal noise detector, (Docket No. 677 at 65), and he has testified that the sub-optimal versions do infringe on CMU’s patents. (*Id.*). Marvell’s infringement expert, Dr. Proakis, similarly agreed that sub-optimality is not part of the infringement analysis.⁸² Furthermore, Marvell cites no legal authority to support its asserted

reviewed these documents on December 19, 2012. The Court took said documents under advisement in reaching its decision on willfulness, but did not base its analysis herein on any document produced under this order. (Docket No. 759 at 186-187) (“It was only the Court which asked for the documents in camera so that [it] could address this issue and the opinion that I looked at.... [T]he Court is also well aware that you can’t draw an inference one way or the other.”).

⁸¹ Marvell’s 30(b)(6) designee on the technology stated,

This (Plaintiff Ex. 93) is KavcicViterbi.cpp class, written by engineers in Marvell, and I do believe it contains the implementation, as understood by our architecture team of the IP which is taught in Professor Kavcic’s papers, and consequently in his patent.

(Docket No. 677 at 170-171; Pl. Ex. 93).

⁸² To this end, Dr. Proakis testified that:

A. I don’t believe suboptimality -- optimality or suboptimality is mentioned in any claims of the patent.

position that complexity constitutes a defense to infringement, and this Court’s research efforts have uncovered no such authority.

Once again, Marvell’s defense is fact-intensive. Whether it was reasonable to believe that the MNP, merely by being “sub-optimal,” did not use the method of the CMU Patents goes to the defendants’ state of mind regarding the alleged infringement. The jury was presented with the convincing testimony of Dr. McLaughlin explaining how the MNP used the methods as well as the 2003 email from Dr. Wu to Mr. Doan stating that he and Mr. Burd were implementing an approach that “turns out to be the original structure that Kavcic proposed in his paper.” (Pl. Ex. 366; Docket No. 677 at 134-135). Ultimately, the jury had to decide what was reasonable based on the credibility of witnesses and the weight to be given to the evidence. *Eschelman v. Agere Sys.*, 554 F.3d 426, 433 (3d Cir. 2009). They found that this was not a reasonable defense (Docket No. 762), and the Court takes this jury verdict on a question of fact as advisory to its overall holding on willfulness. *See Bard*, 682 F.3d at 1008.

Specifically addressing the KavcicViterbi Simulator, Marvell has presented little to rebut CMU’s position that this simulator infringes the patents-in-suit. Mr. Burd outright states that this simulator contained the implementation of the “IP which is taught in Professor Kavcic’s papers and consequently in his patent.” (Docket No. 677 at 167). Marvell’s only argument supporting non-infringement on the KavcicViterbi Simulator appears to be that the patents-in-suit do not cover simulators. (Docket No. 671). To the extent that this is a “reasonable defense,” a jury had to decide this question based on the weight of the evidence and the credibility of same. *See*

Q. So a suboptimal version of an invention that’s covered by a claim can still infringe; right?

A. It may or it may not. It depends on the circumstance.

Q. Right. But sub-optimality doesn’t enter into the analysis at all; does it?

A. No.

(Docket No. 711 at 281-282).

Eschelman, 554 F.3d at 433. Marvell, however, presented no evidence showing that its employees believed the patents-in-suit did not cover simulators at the time of infringement.⁸³ Indeed, Marvell employees considered the Kavcic algorithm the “gold standard” against which they continuously run tests. (Docket No. 677 at 55). And, no evidence was ever presented as to why Marvell believes using the patented technology for comparison and testing purposes negated the need for a license on said technology.

Marvell further argues that CMU’s delay in initiating this lawsuit suggests that the case for infringement is not sufficiently obvious to support a finding of willful infringement. (Docket No. 741 at 8). Given that the willful infringement inquiry depends on the alleged infringer’s conduct rather than the litigation strategy of the patentee, *In re Seagate*, 497 F.3d at 1374, the Court fails to see how CMU’s timing with respect to the litigation is relevant on this issue. Moreover, Dr. Wu testified during trial that it was not possible for anyone outside of Marvell to determine the technology used on the chips without Marvell’s engineers explaining how its chips worked. (Docket No. 709 at 61-64) (“Just like Coca-Cola keeps its formula as a secret...For you to understand how the circuits implemented, the implementation detail, yes, you do need to talk to our people.”). He also stated that he would not have explained to CMU how its chip circuitry was implemented and had never told Dr. Kavcic about the use of his algorithm at Marvell despite meeting him several times.⁸⁴ (*Id.* at. 63:19-63:24). These facts may well have delayed CMU from

⁸³ Certain witness (such Dr. Wu, Mr. Burd, Dr. McLaughlin, and Dr. Blahut) testified to the nature of simulators and whether in their opinion simulators process real or simulated data. (Docket No. 677 at 167-175; Docket No. 707 at 309-311, 322; Docket No. 711 at 261-266; Docket No. 726 at 131-136). However, none spoke to how their beliefs about the nature of simulators affected Marvell’s decision to use the patents-in-suit.

⁸⁴ During trial, Dr. Wu discussed the significance of naming active projects after Dr. Kavcic:

Q. Did you tell Dr. Kavcic you had files named after him?

A No.

Q Why not?

making a determination as to whether it could bring a lawsuit in good faith.⁸⁵ But again, it is the infringer's actions, not the patentee's, that prove willful infringement. *See In re Seagate*, 497 F.3d at 1374.

Marvell asserts again that the Court's comment that Marvell's invalidity defense was a "close call" in its opinion denying summary judgment forecloses a finding of willfulness as a matter of law. (Docket No. 741 at 11). The Court has already indicated that its prior summary judgment rulings do not amount to a finding that an objectively reasonable defense has been presented.⁸⁶ (Docket No. 601, at 4); *Monsanto Co. v. E.I. Dupont de Nemours and Co.*, Civ. No. 09-686, 2012 WL 2979080, at *2 (E.D. Mo. July 20, 2012); *Grant St. Grp., Inc. v. Realauktion.com, LLC*, Civ. No. 09-1407, 2013 WL 2404074, at *3 (W.D. Pa. May 31, 2013).

A Why should I? It's just -- it's like Dr. Viterbi, right? I think I bump into Dr. Viterbi at the conference, should I just approach him and say: Dr. Viterbi, we implemented your algorithm named after you?

(Docket No. 709 at 64). In addition, Mr. Burd and Dr. Wu testified that their references to Dr. Kavcic's name were meant to reference the media noise problem that Dr. Kavcic identified in his paper. (*Id.* at 22).

⁸⁵ The Court is cognizant of Rule 11 of the Federal Rules of Civil Procedure, which establishes the standards that counsel must follow when making written representations to the court. Rule 11(b) of the Federal Rules of Civil Procedure provides in pertinent part:

[b]y presenting to the court a pleading, written motion, or other paper—whether by signing, filing, submitting, or later advocating it—an attorney or unrepresented party certifies that to the best of the person's knowledge, information, and belief, formed after an inquiry reasonable under the circumstances:

...
(3) the factual contentions have evidentiary support or, if specifically so identified, will likely have evidentiary support after a reasonable opportunity for further investigation or discovery[.]

FED. R. CIV. P. 11(b)(3). Generally, Rule 11 "imposes on counsel a duty to look before leaping and may be seen as a litigation version of the familiar railroad crossing admonition to 'stop, look, and listen.'" *Oswell v. Morgan Stanley Dean Witter & Co.*, 507 F. Supp. 2d 484, 488 (D.N.J. 2007) (quoting *Lieb v. Topstone Indus.*, 788 F.2d 151, 157 (3d Cir. 1986)).

⁸⁶ Under Rule 56, the Court may only grant summary judgment if the "movant shows that there is no genuine dispute as to any material fact." FED. R. CIV. P. 56. A defense may be unreasonable even if the Court had earlier found there to be genuine dispute of material facts. *See, e.g., Grant St. Grp.*, 2013 WL 2404074 at *3. Moreover, in considering a motion for a judgment as a matter of law after trial or a motion for a new trial, under Rule 50, the Court looks at the evidence, actually presented at trial, in the light most favorable to the non-movant. *Galena*, 638 F.3d at 196. These standards of review are not one and the same.

Having now examined the trial record as a whole, the Court declines to hold that Marvell's failed invalidity defense affords shelter against a finding of willful infringement. It is clear to the Court that in order for Marvell to have a "reasonable defense" to infringement for the time period of 2001-2009, there needs to be some proof that the basis for such invalidity defense was known to the infringers or even the person having ordinary skill in the art.⁸⁷ In this regard, Marvell's claims at trial rested on the Worstell Patent, U.S. Patent No. 6,282,251, alone. (Def. Ex. 187). Despite same, Marvell proffered no evidence that anyone at Marvell knew of the Worstell Patent from 2001 until this litigation began in 2009. Therefore, Marvell did not have any basis to believe that it could reasonably invoke such a defense to infringement prior to this infringement. Instead, Marvell pursued a course of conduct that was without regard to the potential legal ramifications of infringement. Even if the Court concluded that Marvell has now put forth a reasonable defense to infringement that has been developed during litigation, such a determination would not be dispositive. Rather, the full weight of Marvell's actions as documented in the record and presented at trial precludes the Court from finding that a reasonable person would believe its actions did not involve a high risk of infringement. Further, invalidity of the patents-in-suit was a factual determination to be made in this case.⁸⁸ As such, the reasonableness of reliance on such invalidity defense was also the prerogative of the jury.

⁸⁷ The idea that outside counsel discovering prior art that may invalidate the patent-in-suit, eight years after the start of infringing activity, defeats willful infringement, seems contrary to the spirit of the law. Just because a defendant is able to hire a lawyer to develop a defense to a patent suit, cannot mean that its prior actions no longer ran an "objectively high likelihood of patent infringement." *In re Seagate*, 497 F.3d at 1374 ("in ordinary circumstances, willfulness will depend on an infringer's prelitigation conduct.").

⁸⁸ It would clearly be in error for the Court to have determined that no reasonable defense to infringement exists before the jury even decided the factual underpinnings of invalidity and infringement. To do so would mean the Court's finding of objective willfulness necessitates judgments as a matter of law on validity and infringement, or the Court could be left stating that "no reasonable litigant could realistically expect those defenses to succeed" with the jury possibly finding for the defendant on same. Similarly, it would mean that allowing any defense to go to the jury necessitates a finding of no willful infringement. See *i4i Ltd. P'ship v. Microsoft Corp.*, 598 F.3d 831, 860 (Fed. Cir. 2010) ("The fact that Microsoft presented several defenses at trial, including non-infringement and invalidity, does not mean the jury's willfulness finding lacks a sufficient evidentiary basis.").

Marvell has trotted out a number of different non-infringement or invalidity defenses throughout its four years litigating before the Court. Nevertheless, the Court has consistently found that the issues of infringement and invalidity are to be decided by the jury. To the extent that Marvell again believes the Court should deny a finding of willfulness on the basis that the earlier defenses that were not presented to the jury were reasonable, the Court disagrees. If Marvell thought that any of those “other” defenses were reasonable, it should have presented them to the ultimate finder of fact, the jury.

iii. Conclusion: Objective Willfulness

After taking into account the totality of this litigation, the Court finds the question of whether Marvell acted despite an objectively high likelihood that its actions constituted infringement of a valid patent to be, in part, a question of fact. The Federal Circuit sitting *en banc* held “when the resolution of a particular issue or defense is a factual matter, however, whether reliance on that issue or defense was reasonable under the objective prong is properly considered by the jury.” *Powell v. Home Depot U.S.A., Inc.*, 663 F.3d 1221, 1236-37 (Fed. Cir. 2011). This Court recognizes that the Federal Circuit’s decision in *Bard* holds that this objective recklessness determination is, however, “decided as a matter of law by the judge.” 682 F.3d at 1008. Given the lack of further guidance by the Federal Circuit on how to reconcile these principles in a practical manner for trial, and the Circuit’s own debate on the precedential value of *Bard*,⁸⁹ the Court sent the question of willfulness to the jury for factual findings on an

⁸⁹ In the Federal Circuit’s *en banc* decision in *Highmark, Inc. v. Allcare Health Management Systems, Inc.*, the five-member dissent opinion written by Judge Moore stated “*Bard*’s holding that the objective prong ‘*should always* be decided as a matter of law by the judge’ cannot be reconciled with *Powell* ... For reasons similar to those discussed below, this court should also revisit *Bard* *en banc*.” 701 F.3d 1351, 1357 n.1 (Fed. Cir. 2012) (emphasis in original). Judge Reyna, in another minority dissent, agreed that *Bard* was “a puzzling conclusion ... that we can transform a question of fact into a mixed question of law and fact in order to exclude a jury from deciding what conduct is reasonable.” *Id.* at 1366. Similarly, in Judge Mayer’s original panel dissent in the *Highmark* case, he concluded “that because *Bard* usurps the fact-finding role of the trial courts and is plainly inconsistent with our precedent it is an outlier and of no precedential value.” *Highmark*, 687 F.3d 1300, 1320-21 (Fed. Cir. 2012).

advisory basis. This, the Court believes, is in accord with *Bard*, which affirms that underlying fact questions should be sent to a jury.⁹⁰

In making its ultimate finding, the Court has considered the whole record, including all of the evidence; the jury's verdict on infringement and invalidity; Marvell's knowledge of the patents; and the reasonableness of their defenses; along with the jury's advisory verdict on objective reasonableness.⁹¹ In doing so, the Court, as the final arbiter, finds that CMU has shown by clear and convincing evidence that Marvell acted in disregard of an objectively high likelihood that its actions constituted infringement of a valid patent. Thus, CMU's Motion for a Finding of Objective Willfulness is granted (Docket No. 790), and Marvell's JMOL and/or Motion for New Trial as to Objective Willfulness, (Docket No. 805), is denied.

b. Subjective Prong

Under the subjective prong of willful infringement, "the patentee must also demonstrate that this objectively-defined risk (determined by the record developed in the infringement proceeding) was either known or so obvious that it should have been known to the accused infringer." *Powell*, 663 F.3d at 1236. The jury ultimately determines whether this subjective prong is met. *Id.* Notwithstanding a finding of objective willfulness, Marvell further maintains

⁹⁰ Initially, the Court had contemplated sending interrogatories to the jury on the factual issues underlying the objective prong of willfulness, but it became apparent that this was not feasible given the number of claims, disputed facts, and defenses presented. For example, in considering Marvell's belief that its invention was "less complex," a jury needed to weigh the "complexity" of the patents-in-suit, the Accused Technology, the Marvell patents, the relationship between same, and the credibility of the witnesses who claimed to believe they were not infringing due to this factor, balanced against all of Marvell's infringing activity. Further, this is not a case in which the defenses were tried in prior proceedings. With the parties' agreement, infringement, validity, damages, and willfulness were all presented to the jury in one trial.

⁹¹ The jury verdict addressed objective reasonableness as follows: "Did Marvell have actual knowledge of the [patents] prior to commencement of this lawsuit (in other words, prior to March 6, 2009)?" and "If Marvell learned of the [patents] and prior to commencement of this lawsuit, did Marvell have an objectively reasonable defense to CMU's claim of infringement?" (Docket No. 762 at 6-7). On subjective willfulness, the jury was asked "If Marvell learned of the [patents], do you find clear and convincing evidence that Marvell actually knew or should have known that its action would infringe the [claims of the patents]." (*Id.*).

that no reasonable jury could find that Marvell possessed the requisite subjective intent for willful infringement. (Docket No. 741 at 13).

Again, the evidence presented at trial belies Marvell's assertions. CMU has presented sufficient evidence that would permit the jury to find that Marvell's engineers worked on multiple projects bearing Kavcic's name, clearly indicating that those engineers were aware that Dr. Kavcic had a hand in creating this technology. Moreover, Marvell's failure to investigate the patents despite the high likelihood of infringement militates against a finding that it had a subjectively reasonable basis for believing that it was not infringing or that the patents were invalid.

In addition, as the Court has already explained, the conduct of Marvell's engineers in copying Dr. Kavcic and Dr. Moura's work as described in their papers is relevant to finding that Marvell had a subjective intent to infringe. CMU presented evidence at trial showing that Marvell's engineers duplicated the technology described in Dr. Kavcic and Dr. Moura's papers in their chips and simulators, as testified to by Dr. McLaughlin. (Docket No. 677 at 54-55). The evidence shows that shortly after beginning work on the Kavcic model, Mr. Burd prepared a preliminary write-up of the KavcicPP detector which referenced the work of Dr. Kavcic and Dr. Moura. (Pl. Ex. 280). Again, Dr. McLaughlin testified that this KavcicPP write-up became the MNP circuit. (Docket No. 677 at 66-67). Although Mr. Burd stated that he was "generally following the papers," not the patents, and that he "left it at that," (*Id.* at 77), Dr. McLaughlin testified that the papers are virtually identical to what is described in the patents. (*Id.* at 66-67).

The evidence also showed that when Kavcic's name was disassociated with the project, there was no functional difference between the old and new computer codes. (Pl. Ex. 368; Docket No. 677 at 81). Dr. Wu informed Mr. Doan that he and Mr. Burd were working on a

model that ended up being the original structure that Kavcic proposed in his paper. (Pl. Ex. 366; Docket No. 677 at 134-135). Dr. McLaughlin confirmed that the NLD used the original structure proposed in Dr. Kavcic's paper, and subsequently in the CMU Patents. (Docket No. 677 at 136-137). This evidence of copying contributes to the Court's finding that Marvell acted in a subjectively reckless manner with respect to the risk of infringing the subject patents.

In arguing that it lacked knowledge about the underlying infringement, Marvell points out that CMU acknowledged its reputation as a technology innovator. The Court fails to see how this pertains to whether Marvell knew or should have known that its actions ran an objectively high risk of infringing the patents-in-suit. The Court also finds unavailing Marvell's alternative argument that CMU's failure to follow-up on its 2003 licensing letters lulled it into a false sense of security. Nothing disclosed at trial even indicated that any person at Marvell considered the implications of these licensing letters. Nor was there testimony from Marvell employees stating that they were aware CMU failed to follow up with other inquiries. Rather, when presented with potential warnings about the risk of infringement, Marvell ignored them and proceeded ahead in developing read channel technology based on Dr. Kavcic and Dr. Moura's work.

For all of these reasons, after considering all of the evidence in this case in the light most favorable to CMU, and drawing all reasonable inferences in its favor on subjective willfulness, the Court denied Marvell's original and renewed Motion for Judgment as a Matter of Law on Willful Infringement, (Docket Nos. 699; 740), and denies Marvell's JMOL now. (Docket No. 805). Likewise, the Court finds CMU presented sufficient evidence on which a jury could have found that Marvell knew or should have known about the substantial risk of infringement. Thus, the verdict on subjective willfulness is not against the great weight of evidence and Marvell's

request for a new trial is not justified. As such, the Court grants CMU's Motion for a Finding of Willful Infringement. (Docket No. 790).

D. Damages

The Court also considers Marvell's Motion for Judgment as a Matter of Law, New Trial and/or Remittitur with Respect to Damages, along with related briefing. (Docket Nos. 807; 808; 829; 855; 857). In these motions, Marvell renews arguments from its at-trial JMOL. (Docket Nos. 701; 702; 725; 738; 739). In sum, Marvell maintains that the jury award of \$1.169 billion is legally unsound and factually unsupported. (Docket No. 808). CMU counters that the award is in accord with the governing statute and Federal Circuit precedent, and supported by the facts of record. (Docket No. 829).

1. Legal Standard

As the Court has set forth in a number of prior decisions, in a patent infringement action, a successful plaintiff is entitled to "damages adequate to compensate for the infringement, but in no event less than a reasonable royalty for the use made of the invention by the infringer, together with interest and costs as fixed by the court." 35 U.S.C. § 284. Two forms of compensation are authorized by § 284: lost profits and reasonable royalty damages. *Lucent Techs., Inc. v. Gateway, Inc.*, 580 F.3d 1301, 1324 (Fed. Cir. 2009). Because CMU does not manufacture or sell products that practice the claimed methods, it is not entitled to lost profits. CMU thus bears the burden of proof to establish its damages at trial through a reasonable royalty. *See Lucent*, 580 F.3d at 1324 (citation omitted) ("The burden of proving damages falls on the patentee.").

"A reasonable royalty contemplates a hypothetical negotiation between the patentee and the infringer at a time before the infringement began." *Red Hat*, 705 F. Supp. 2d at 689 (citing

Hanson v. Alpine Valley Ski Area, Inc., 718 F.2d 1075, 1078 (Fed. Cir. 1983)). The hypothetical negotiation assumes two preconditions are met: (1) that both the patentee and the accused infringer are willing parties to the negotiation, and (2) that the patent was valid, enforceable, and infringed. *Georgia-Pacific Corp. v. U.S. Plywood Corp.*, 318 F. Supp. 1116, 1120 (S.D.N.Y. 1970). The *Georgia-Pacific* case sets out a series of factors that may be relevant to the analysis of a reasonable royalty. *Id.* “Although some approximation is permitted in calculating the reasonable royalty, the Federal Circuit requires ‘sound economic and factual predicates’ for that analysis.” *Red Hat, Inc.*, 705 F. Supp. 2d at 689 (quoting *Riles v. Shell Exploration & Production Co.*, 298 F.3d 1302, 1311 (Fed. Cir. 2002) (citation omitted)); *see also i4i*, 598 F.3d at 857-58 (citing *Lucent*, 580 F.3d at 1325) (“any reasonable royalty analysis necessarily involves an element of approximation, and uncertainty”).

In general, the determination of compensatory damages is within the province of the jury and is entitled to great deference.” *Dee v. Borough of Dunmore*, 474 F. App’x 85, 87 (3d Cir. 2012). The United States Court of Appeals for the Third Circuit⁹² has held that a remittitur is appropriate if the trial judge concludes that a jury verdict is “clearly unsupported and/or excessive.” *Cortez v. Trans Union, LLC*, 617 F.3d 688, 715 (3d Cir. 2010). The reduction may not be less than the maximum amount that does not “shock the judicial conscience.” *Evans v. Port Auth. of N.Y. & N.J.*, 273 F.3d 346, 355 (3d Cir. 2001). If remittitur is granted, the party against whom it is entered can accept it or can proceed to a new trial on the issue of damages. *Martik Bros., Inc. v. Huntington Nat’l Bank*, Civ. No. 08-83, 2010 WL 2041065, at *1 (W.D. Pa. May 20, 2010).

⁹² While the substantive law of patent damages is reviewed under Federal Circuit precedent, the “decision to grant or withhold a remittitur [is decided] under the law of the regional circuit.” *Power Integrations, Inc. v. Fairchild Semiconductor Int’l, Inc.*, 711 F.3d 1348, 1356 (Fed. Cir. 2013).

2. Background

The issues surrounding CMU's damages claim have been addressed numerous times in this case, from the early days of discovery disputes (Docket No. 195), to summary judgment (Docket No. 441), in motions *in limine* (Docket No. 493), and "emergency" motions (Docket No. 656), during trial (Docket No. 713), and now again post trial. At the earlier stages, the Court ruled based upon the evidence submitted by the parties and what it expected to hear at trial. (*Id.*). Unsurprisingly, a significant portion of the trial focused on determining damages.

CMU's liability theories against Marvell are critical to understanding the jury's damages award. At trial, CMU argued that that Marvell directly infringed the CMU Patents by using the method of the patents during its sales cycle as well as indirectly infringed by inducing and contributing to the infringement by its customers in the United States. As already discussed, the evidence presented through the testimony of Dr. Bajorek, CMU's industry expert, Marvell's SEC filings (Pl. Ex. 198), and the joint stipulation by the parties (Pl. Ex. 938), established that Marvell sells its chips through a lengthy, expensive sales cycle during which Marvell "invest[s] significant resources with each potential customer without any assurance of sales to that customer." (Docket No. 707 at 32-35). At the end of a given sales cycle, Marvell achieves a "design win" if "the customer decides to go into production" with Marvell and actually does so. (*Id.*). Such a design win is generally a winner-take-all affair in the HDD industry, which typically results in the winner becoming the exclusive supplier for the customer's specific hard drive or generation of hard drives. (*Id.*). Simulation programs are used throughout the sales cycle to formulate the concepts and basic designs, research and develop new products, refine and evaluate chip designs before incurring the cost of setting the chips in silicon, among other ways. (*Id.*). Once the simulation programs have satisfactory results, an engineering sample chip is

created in Asia and sent back to domestic offices for continued refinement, testing, and evaluation with Marvell engineers and its customers. (Docket No. 678 at 105-106; Docket No. 707 at 164). If the customer is satisfied and places an order, the chips are put into volume production and manufactured in Asia. (Docket No. 707 at 164). Following Marvell's "design win," it would become the exclusive supplier for a customer's specific hard drive or generation of hard drives. (*Id.* at 32-35). A portion of these chips comes back to the United States through the chain of commerce in hard drives and/or laptops. (Docket No. 710 at 360-361). As Dr. Bajorek testified, the "sales cycle sequence" takes "three or four years to complete" and "with the exception of the chip making, which is made by a foundry in Taiwan, all the activities related to designing, simulating, designing [*sic*], testing, evaluating, qualifying the chips by Marvell as well as by its customers occurs in the United States." (Docket No. 678 at 105).

Much of this sales cycle activity uses the methods claimed in the CMU Patents. Through evidence regarding this sales cycle, CMU proved Marvell's direct infringement by: (1) use of the method in the KavcicViterbi simulator, which all chips are tested against to evaluate their performance and used to develop greater SNR gain; (2) use of the method by the Chip Simulators (KavcicPP, MNP, EMNP, and NLD Simulators) during the research, development, design, qualification and testing phases for the corresponding chips; and (3) use of the method in Accused Chips as engineering samples, sometimes called "golden chips," that Marvell uses during the sales cycle. (Docket No. 678 at 78-82; Docket No. 673 at 156-178). CMU demonstrated that these three scenarios of direct infringement all arise in the United States during Marvell's sales cycle. CMU also successfully argued contributory infringement and induced infringement through Marvell's customers' use of the patented method in the Accused Chips in the United States. (Docket No. 759). CMU has never asserted infringement against

Marvell for any use of its patented methods which did not occur in the United States, nor does it seek damages for instances of foreign infringement.

With these theories of infringement in mind, the Court turns to the problem of quantifying the volume or the value of the “use” of the patented methods during the sales cycles. This issue has been hotly contested by the parties throughout this litigation, and, as the case progressed towards trial, it became clear that there were only a limited number of options to value “use.” First, calculating a reasonable royalty on the simulators and/or engineering samples was not promising as they are not products in the market place. Thus, such a hypothetical negotiation led back to the initial question of how to quantify use of patented methods during such a sales cycle. The second potential solution was to quantify a fee per use of the patented method. *See Sinclair Ref. Co. v. Jenkins Petroleum Process Co.*, 289 U.S. 689, 697 (1933) (“[t]he use that has been made of the patented device is a legitimate aid to the appraisal of the value of the patent at the time of the breach.”). However, quantifying a per use fee in this case is nearly impossible, as the patented method is literally run hundreds of millions of times per second. (Docket No. 677 at 38). By the Court’s rough calculation, assuming an eight hour work day, and 100 million runs per second, there are a minimum of 2.88 trillion infringing uses, per single chip or simulator, per day. Given same, if Marvell would rather negotiate a fee based on such use, the Court is certain CMU would be more than willing, but such astronomical numbers make this method extremely impractical. *See, e.g., Lucent*, 580 F.3d at 1334 (“A company licensing a patented method often has strong reasons not to tie the royalty amount strictly to usage. The administrative cost of monitoring usage can be prohibitively expensive.”).

The third option quantifies the use of the patented methods during this sales cycle based on a reasonable royalty for the sales that arose from the sales cycle. CMU proffered this theory

and the Court ruled on several occasions that Marvell's sales could be an appropriate metric for assessing the value of the use of the patented methods in the U.S. by Marvell and its customers. (Docket Nos. 441; 672). Accordingly, CMU was permitted to present this theory to the jury, and Marvell was given a full opportunity to rebut this valuation method.

To support this theory, CMU called Catherine Lawton as its damages expert and she opined that the value of the patented method would be a royalty of \$0.50 on all chips sold by Marvell as a result of the sales cycle. (Docket No. 686 at 29). Her calculations resulted in her opinion that CMU's damages are \$1.169 billion. (*Id.*). Marvell rebutted this damages calculation by presenting its own damages expert, Creighton Hoffman, who opined that a reasonable royalty in this case would be a one-time royalty payment of \$250,000.00. (Docket No. 709 at 242-245). At the conclusion of trial, the Court instructed the jury:

Marvell cannot be found to have directly or indirectly infringed in connection with chips that are never used in the United States. To the extent, however, that Marvell achieved sales resulting from Marvell's alleged infringing use during the sales cycle, you may consider them in determining the value of the infringing use...

The damages you award must be adequate to compensate CMU for the infringement. Damages are not meant to punish an infringer. Your damages award, if you reach this issue, should put CMU in approximately the same financial position that it would have been in had the infringement not occurred, but in no event may the damages award be less than what CMU would have received had it been paid by Marvell a reasonable royalty. CMU has the burden to establish the amount of its damages by a preponderance of the evidence. In other words, you should award only those damages that CMU establishes that it more likely than not suffered. In this case CMU seeks a reasonable royalty. A reasonable royalty is defined as the monetary amount CMU and Marvell would have agreed upon as a fee for use of the invention in the United States at the time prior to when the infringement began.

(Docket No. 764 at 62-63, 80-81). Against this backdrop, the jury returned a verdict in favor of CMU on all forms of direct and indirect infringement, validity, and willfulness, ultimately assessing \$1.169 billion in damages for CMU. (Docket No. 762).

Having considered the applicable legal standard against the facts of record, the Court finds that CMU had presented sufficient evidence from which the jury could have found that CMU is entitled to damages authorized by 35 U.S.C. § 284, as expressed by the expert opinion of Ms. Lawton, i.e., CMU is entitled to a reasonable royalty of \$0.50 per chip sold by Marvell. Of course, the jury could have found that Ms. Lawton's testimony was not credible, or it could have favored the expert testimony of Mr. Hoffman and awarded any figure he believed was appropriate. *See Micro Chem.*, 317 F.3d at 1394. The jury also could have reached a different verdict altogether from any amount that was suggested by either expert and awarded a greater or lesser sum. It is not the Court's role to weigh the factual disputes presented by the parties at trial. *Eschelman*, 554 F.3d at 433. Likewise, it is not the Court's duty to usurp the jury's fact finding role when it reached a verdict on damages that was within the calculations proffered by the competing experts. Both parties came into trial knowing that \$1.169 billion was within the range of possible compensatory verdicts. This is not a punitive award. It is the exact award sought by CMU. (Docket No. 671 at 132). As such, the jury's verdict is not against the great weight of evidence as to mandate a new trial on damages. Nor is the verdict clearly unsupported such that remittitur is warranted. For completeness, the Court now briefly addresses the bevy of arguments advanced by Marvell to limit damages in this case, which can be categorized as either challenges to the royalty base or the royalty rate.

3. Challenges to the Royalty Base

a. Argument Based on *Power Integrations*

Marvell has repeatedly challenged the Court’s decision to allow CMU to value Marvell’s use of the CMU Patents by considering all the chips that were sold under the aforementioned sales cycle. (Docket Nos. 356; 656; 808). The Court first ruled on the inclusion of extraterritorial conduct at summary judgment. (Docket No. 441). Motions *in limine* were due September 24, 2012. (Docket No. 315). Marvell did not raise this issue in a motion *in limine*; instead, it waited until the last minute to file an “Emergency Motion to Strike CMU’s Attempt to Include Noninfringing Sales of Chips that Are Never Used in the US in its Damages Case It Intends to Present to the Jury” on the Saturday after Thanksgiving, two days before the start of trial.⁹³ (Docket No. 656) (emphasis added). Consequently, the Court reiterated, in response to this “emergency” motion:

CMU intends to prove that the alleged infringing method is used during Marvell’s sales cycle, which is performed here in the United States, where both its engineers and customers are located. (Docket No. 665). CMU seeks damages for this sales cycle infringement by claiming a reasonably royalty rate on all of the chips that are produced during this sales cycle and purchased based on the result of said cycle.

To be clear, CMU does not seek damages from alleged infringement of the Accused Chips that are never used in the United States, because the Court has held the extra-territorial sales are not infringing (Docket No. 441), it seeks damages on the infringement from the U.S. based sales cycle, and has chosen to quantify these damages by applying a per chip royalty rate on all Accused Chips produced under the sales cycle. (*Id.*). Marvell will have a full opportunity at trial to argue that this quantification is unreasonable.

(Docket No. 672 at 5-6).

⁹³ The Court notes that in October and November of 2012, eight new attorneys entered their appearances to take the lead at trial for Marvell. (Docket Nos. 550-554; 599; 600; 630). The Court is not sure why this strategy was employed. In any event it resulted in a complete changeover of lead counsel for Marvell from all prior proceedings.

During this post-trial stage, Marvell’s now claims that the Federal Circuit’s holding in *Power Integrations, Inc. v. Fairchild Semiconductor Int’l, Inc.*, 711 F.3d 1348 (Fed. Cir. 2013), precludes consideration of all of Marvell’s chips in computing a reasonable royalty.⁹⁴ (Docket No. 855). Having fully considered the law, the arguments of the parties, and the evidence presented at trial, the Court does not believe that *Power Integrations* overrules this Court’s earlier decisions.⁹⁵

In *Power Integrations*, the plaintiff argued for an award of damages on the lost profits from foreign sales which it would have made but for the defendant’s domestic infringement. *Power Integrations, Inc.*, 711 F.3d at 1371. In holding that such foreign lost profits were not cognizable damages, the Circuit held that the question presented in the end was whether the plaintiff was “entitled to compensatory damages for injury caused by infringing activity that occurred outside the territory of the United States.” *Id.* at 1371. The Circuit panel held that “the entirely extraterritorial production, use, or sale of an invention patented in the United States is an independent, intervening act that, under almost all circumstances, cuts off the chain of causation initiated by an act of domestic infringement.” *Id.* at 1371-1372 (finding that the damages expert’s “estimate of \$30 million in damages was not rooted in [the defendant’s] activity in the United States”).

The *Power Integrations* fact pattern is quite distinct from the facts at hand. First, this case has nothing to do with lost profits. Second, unlike the situation in *Power Integrations*, CMU does not seek “damages for injury caused *by infringing activity that occurred outside the territory of*

⁹⁴ New counsel have only recently, post trial, joined the cause, (Docket Nos. 776; 777), and bring with them new issues for the Court to address.

⁹⁵ The Court notes that *Power Integrations*’ request for rehearing and rehearing *en banc* has been denied, but it has indicated it intends to seek Supreme Court review on the damages issue. *See Power Integrations v. Fairchild*, Civ. No. 04-1371 (D. Del.) at (Docket No. 812).

the United States.” Id. at 1371 (emphasis added). The Court reiterates that CMU has always sought damages for domestic infringement resulting from Marvell’s use of the patented methods during research, development, chip design, qualification, use of engineering samples, continuous evaluation and indirect infringement by end users in the United States. (Docket No. 860 at 5; Docket No. 678 at 70-162). There was ample evidence presented at trial to establish that these infringing activities occur in the United States. Dr. McLaughlin testified at length to establish that the MNP and NLD chips and KavcicPP, MNP, EMNP, NLD, and Kavcic Viterbi Simulators infringed the methods. (Docket No. 673 at 156-178). Dr. Bajorek then, in turn, explained how these chips and simulators are used during the sales cycle. (Docket No. 678 at 76-90). He next testified that all steps of the sales cycle, other than physical production of the chips, occur in the United States, adding that he had personally been to each of the customer’s design centers in the United States. (Docket No. 678 at 105) (“Hitachi, San Jose. Samsung in San Jose. Toshiba in San Jose. And Western Digital in San Jose, in Lake Forest, which is southern California. In Longmont and Fremont, several design centers by Seagate.”). He provided the following demonstrative for the jury, which tabulated some of the infringing sales cycle activities, the participants, the place of the activity, and the pinpoint reference citation supporting his conclusion:

Where Marvell's "Sales Cycle" Activities Takes Place					
Activity	Specific Activity	Who Participates?	Activity Occur in the US?	Where in the US Does This Activity Occur?	Exhibit or Testimony
Tapeout	Accused Chip design development and finalization	Marvell Semiconductor, Inc.	Yes	Santa Clara, CA	Armstrong Vol. 3 (Dec. 16, 2010) at 151:9-152:9
		Marvell Semiconductor, Inc.	Yes	Santa Clara, CA	A. Armstrong Vol. 3 (Dec. 16, 2010) at 152:4-157:10
	Transfer final Accused Chip design to overseas foundry for fabrication of engineering samplers	Marvell Semiconductor, Inc.	Yes	Santa Clara, CA	T. Doan at 82:22 – 83:6
	Engineering samples are shipped from the overseas foundry to Marvell Semiconductor, Inc. Santa Clara prior to distribution to customers	Marvell Semiconductor, Inc.	Yes	Santa Clara, CA	P. Patel at 60:2-61:21
		Marvell Semiconductor, Inc.	Yes	Santa Clara, CA	P. Patel at 113:2 – 114:22
	Engineering samples supplied to customers	Marvell Semiconductor, Inc.	Yes	Santa Clara, CA	A. Armstrong Vol. 3 (Dec 16, 2010) at 157:13 - 161:1
Western Digital Marvell Semiconductor, Inc.		Yes	Lake Forest, CA	Brennan at 328:20 – 329:7	
Validation / Qualification of Samples	ATE Test Program Development and ATE Hardware Design	Marvell Semiconductor, Inc.	Yes	Santa Clara, CA	Armstrong Ex. 114 (Decl. of A. Wu)
		Marvell Semiconductor, Inc.	Yes	Santa Clara, CA	A. Wu at 46:17 – 47:8
		Marvell Semiconductor, Inc.	Yes	Santa Clara, CA	A. Armstrong Vol. 1 (June 23, 2010) at 86:14-87:10; 88:22 – 25
		Marvell Semiconductor, Inc.	Yes	Santa Clara, CA	A. Armstrong Vol. 1 (June 23, 2010) at 91:3 – 94:8
		Marvell Semiconductor, Inc.	Yes	Santa Clara, CA	A. Wu at 46:17 – 47:7
	ATE Testing	Marvell Semiconductor, Inc. MAPL	Yes, but not exclusively	Santa Clara, CA	A. Wu at pp 44:4 – 46:2
		Marvell Semiconductor, Inc.	Yes, but not exclusively	Santa Clara, CA	A. Wu at pp 45:9 – 46:2
		Marvell Semiconductor, Inc. MAPL	Yes, but not exclusively	Santa Clara, CA	A. Armstrong Vol. 1 (June 23, 2010) at 91:3 – 94:8

Where Marvell's "Sales Cycle" Activities Takes Place					
Activity	Specific Activity	Who Participates?	Activity Occur in the US?	Where in the US Does This Activity Occur?	Exhibit or Testimony
Validation / Qualification of Samples (continued)	Testing and Evaluation of Samples	Marvell Semiconductor, Inc.	Yes	Santa Clara, CA	Armstrong Ex. 114 (Decl. of A. Wu)
		Marvell Semiconductor, Inc.	Yes, but not exclusively	Santa Clara, CA	S. Huang at pp. 26:15-27:1
		Marvell Semiconductor, Inc.	Yes	Santa Clara, CA	A. Armstrong Vol. 3 (Dec. 16, 2010) at pp 159:10-162:4
		Marvell Semiconductor, Inc.	Yes	Santa Clara, CA	A. Nazari at 32:3-33:20
		Marvell Semiconductor, Inc.	Yes	Santa Clara, CA	A. Nazari at 30:7-31:20
		Marvell Semiconductor, Inc.	Yes	Santa Clara, CA Lake Forest, CA (WD) San Jose, CA (TAIS)	R. Pai at 42:23-43:8; 44:23-45:21
		Marvell Semiconductor, Inc.	Yes	Santa Clara, CA	A. Wu at pp 37:13-38:2; 40:9-40:20; 44:4-46:2 A. Wu Ex. 27 at Marvell Semiconductor, Inc. 2137382
		Marvell Semiconductor, Inc.	Yes, but not exclusively	Santa Clara, CA	S. Huang at 232:18-233:10
		Marvell Semiconductor, Inc.	Yes	Santa Clara, CA	A. Armstrong Vol. 1 (June 23, 2010) at 83:9-84:14
		Marvell Semiconductor, Inc.	Yes, but not exclusively	Santa Clara, CA Colorado	Z. Wu at pp 249:1-250:9
	Validation of Accused Chips (including validation of MNP, EMNP, NLD)	Marvell Semiconductor, Inc.	Yes, but not exclusively	California	V. Khanzode at pp 153:22-154:12
		Marvell Semiconductor, Inc.	Yes, but not exclusively	Santa Clara, CA Colorado	V. Khanzode at pp 30:15-31:10
		Marvell Semiconductor, Inc.	Yes, but not exclusively	Santa Clara, CA	A. Nazari at 104:18-104:20
		Marvell Semiconductor, Inc.	Yes, but not exclusively	Santa Clara, CA	V. Khanzode at pp 59:21-60:20; 140:18-143:16
		Marvell Semiconductor, Inc.	Yes	Santa Clara, CA	S. Huang at 39:14-19;
		Marvell Semiconductor, Inc.	Yes	Santa Clara, CA	S. Huang at pp. 90:24-91:11
	MNP, EMNP, and NLD optimization	Marvell Semiconductor, Inc.	Yes	Santa Clara, CA	S. Huang at 44:3-45:4
		Marvell Semiconductor, Inc.	Yes	Santa Clara, CA	S. Huang at 46:2-46:21
		Marvell Semiconductor, Inc.	Yes	Santa Clara, CA	S. Huang at 122: 10-18
		Marvell Semiconductor, Inc.	Yes	Santa Clara, CA	S. Huang at 32:18-39:25
	Customer testing and optimization of Accused Chips	Western Digital	Yes	Lake Forest, California	Khanzode Ex. 46
		Maxtor	Yes	California	Khanzode Ex. 10
		SISA (Samsung)	Yes	San Jose, CA	A. Nazari at 19:19-20:9
		SISA (Samsung)	Yes	San Jose, CA	A. Nazari at 29:25-30:22
		SISA (Samsung)	Yes	San Jose, CA	A. Nazari at 33:12-33:20
		TAIS (Toshiba)	Yes	San Jose, CA	S. Huang at 30:15-30:20
		TAIS (Toshiba)	Yes	San Jose, CA	S. Huang at 23:15-25:10

Where Marvell's "Sales Cycle" Activities Takes Place					
Activity	Specific Activity	Who Participates?	Activity Occur in the US?	Where in the US Does This Activity Occur?	Exhibit or Testimony
Marvell Customer Support	Direct assistance of customers for training, evaluation and optimization of the Accused Chips	SISA (Samsung)	Yes	San Jose, CA	A. Nazari at 33:15-33:20
		SISA (Samsung)	Yes	San Jose, CA	A. Nazari at 30:7-31:20
		SISA (Samsung)	Yes	San Jose, CA	A. Nazari at pp. 19:3-20:9
		HGST (Hitachi) Marvell Semiconductor, Inc.	Yes	San Jose, CA	S. Huang at pp. 126:7-127:17
		HGST (Hitachi) Marvell Semiconductor, Inc.	Yes	San Jose, CA	Huang Ex. 4 at Marvell Semiconductor, Inc. 2482540, -543
		Western Digital Marvell Semiconductor, Inc.	Yes	Lake Forest, CA	Khanzode Ex. 46
		Western Digital Marvell Semiconductor, Inc.	Yes	Irvine, CA	T. Tran at pp. 19:9-20:2
		Marvell Semiconductor, Inc. Western Digital Seagate Hitachi Samsung	Yes	Lake Forest, CA (WD) San Jose, CA (Samsung) Rochester, MN (Hitachi) Twin Cities, MN (Seagate)	M. Modlen at pp. 21:24-26:6
		TAIS (Toshiba)	Yes	San Jose, CA	S. Huang at pp. 23:13-25:13
		TAIS (Toshiba)	Yes	San Jose, CA	S. Huang at pp. 26:24-27:15
Failure Analysis	Create and supply reference firmware for Accused Chips to customers	Marvell Semiconductor, Inc.	Yes	Santa Clara, CA	A. Nazari at 194:2-21
		Marvell Semiconductor, Inc.	Yes	Santa Clara, CA	A. Nazari at pp. 163:1-164:21
		SISA (Samsung)	Yes	San Jose, CA	Pai Ex. 31
	Failure analysis testing	Marvell Semiconductor, Inc.	Yes, but not exclusively	Santa Clara, CA	P. Patel at 112:5-114:22
Failure Analysis	Development of ATE tests for failure analysis	Marvell Semiconductor, Inc.	Yes	Santa Clara, CA	P. Patel at 227:7-20
	Failure analysis reports prepared	Marvell Semiconductor, Inc.	Yes, but not exclusively	Santa Clara, CA	P. Patel at 38:16-39:4

(Docket No. 771 at Ex. I). Dr. Sutardja, likewise, testified that the sales cycle process occurs in the United States for its largest customers such as Seagate, Western Digital, Samsung, Quantum, Maxtor, Toshiba, and possibly Hitachi. (Docket No. 707 at 132-133; Docket No. 868 at Ex. 1). Mr. Yeo, Western Digital's corporate designee also testified that the MNP and NLD technology was tested as part of drive development in the United States. (Docket No. 761 at Jt. Ex. B at 41-43). Additionally, the parties entered into a stipulation which reads in part:

Eight, the headquarters and principal place of business of Marvell Semiconductor, Inc., also known as MSI, is located at 5488 Marvell Lane, Santa Clara, California.

Nine, the management and strategic decision-making of MSI as well as most of its business activities are conducted at MSI Headquarters in Santa Clara, California.

....

Eleven, the accused read channel and SOC products in this case were researched, designed, and developed in MSI's headquarters in Santa Clara, California.

Twelve, as of June of 2009, MSI's system and design teams for the read channel R&D organization consisted of approximately 133 employees, of whom approximately 131 were located at MSI's facility in Santa Clara, California.

Thirteen, Dr. Zining Wu, vice-president of data storage technology, Toai Doan, former vice-president for signal processing technology and read channel product development, and Greg Burd, senior manager of engineering, are knowledgeable about the design, operation, and features of the accused read channel products, particularly as related to the technology area of the patents asserted in this litigation. All three of them work or worked in northern California, and the managerial functions that they carried out on a daily basis are essential to MSI's ongoing data storage business operations.

Fourteen, almost all of the design and development documents from MSI's read channel R&D organization are located in Santa Clara, California.

....

Eighteen, MSI's manufacturing operations group generally supports read channel research and development rather than commercial production activities. MSI's manufacturing operations group supports MSI's read channel R&D through, for example, ATE test development, product characterization, qualification, and oversight of product transfer during read channel product development. These activities are conducted in Santa Clara, California.

Nineteen, as of June, 2009, approximately fifty employees from Marvell's manufacturing operations group who support read channel research and development work at Marvell's facilities in Santa Clara, California.

Twenty, Albert Wu, vice-president of manufacturing operations, works in northern California, managed those fifty employees in June of 2009; and the managerial functions that he carries out on a daily basis are essential to MSI's ongoing operations support for research and development.

Twenty-one, MSI's operations documents concerning the accused read channel products are located in Santa Clara, California.

(Docket No. 764 at 49-56; Pl. Ex. 938).

Upon review of the record, the Court can find no evidence regarding whether any step of the sales cycle process occurred anywhere other than in the United States. Indeed, Marvell proffered almost no evidence regarding its business operations to rebut CMU's arguments on

infringement, sales, or damages.⁹⁶ Accordingly, CMU has shown that the infringement for which it seeks damages occurred within the United States, clearly distinct from the *Power Integrations* foreign exploitation of a patented invention.⁹⁷ 711 F.3d at 1371.

Even after *Power Integrations*, the Court must still confront the question of how to quantify damages for Marvell's use of the method patents at issue. As the Court discussed, a fee per use is unrealistic. Moreover, no established fee exists. At trial, Marvell argued that a one-time fee of \$250,000 was the appropriate measure of damages, (Docket No. 809), while CMU countered that a reasonable fee should be a \$0.50 royalty per chip on all chips created through this sales cycle. (Docket No. 829). The Court has never endorsed either side's position, only ruling that CMU's theory could be presented to the jury. Based on the evidence before it, the Court found CMU's theory just as reasonable as Marvell's. Accordingly, the jury considered both positions. Furthermore, the Court properly instructed the jury that Marvell could not infringe "with chips that are never used in the United States" but "[t]o the extent, however, that Marvell achieved sales resulting from Marvell's alleged infringing use during the sales cycle, you may consider them in determining the value of the infringing use."

In requesting the Court to follow *Power Integrations*, Marvell asks the Court to limit CMU's royalty to an estimate of chips that came back into the United States in the stream of commerce. This proposition, however, is lacking in evidentiary support and common sense. Marvell did not submit evidence at trial that it or any company has ever licensed patented

⁹⁶ This is not to say that Marvell had the burden of proof on damages, *see Lucent*, 580 F.3d at 1324, but only that CMU has presented unchallenged direct and circumstantial evidence to establish the sales cycle occurred in the United States.

⁹⁷ As part of her damages evaluation, Ms. Lawton considered whether Marvell, in order to avoid infringement, could move its design and sales centers overseas. (Docket No. 686 at 223-224). She determined, however, based on Dr. Bajorek's testimony, that it was key to Marvell's business success to be in California where the majority of its customers were based and where there was the largest pool of talent. (*Id.*). As such, moving the research, design, testing, sales and marketing centers overseas was not a potential option. (*Id.*).

technology on a per United States imported chip basis. The *only* Marvell license submitted into evidence at trial (by CMU no less), was between Marvell Technology Group and DSPG signed in April 2000. (Pl. Ex. 197). According to the licensing arrangement, Marvell was to pay a \$2.1 million fee plus a running royalty between \$0.10 to \$0.40 per unit, after 35 million units are produced.⁹⁸ (*Id.* at 79). The royalties paid to DSPG are not linked to the units' location in any particular country.⁹⁹ (*Id.*). Likewise, Dr. Sutardja, Dr. Armstrong, and Mr. Brennan did not testify that Marvell would have, or had ever, entered into an agreement which limited royalties to chips in the United States, only. Dr. Armstrong did testify, however, that Marvell had entered into running royalty agreements on chips, referring for instance to the aforementioned DSPG contract. (Docket No. 761 at Ex. C at 15-16). The major concern with limiting a royalty for sales cycle infringement to chips in the United States is that no one, including Marvell, tracks how many chips come back into the country. (Docket No. 356-1; Docket No. 710 at 361).¹⁰⁰ For the purposes of this trial, Ms. Lawton projected two estimates: the first, 556,812,092 chips, based on adjusted industry analytics of HDDs imported into the United States; and the second, 329,297,799 chips, based on the import records of Marvell's four largest customers, i.e., Samsung, Hitachi, Western Digital, and Toshiba. (Docket No. 356-1 at 488-489; Docket No. 710 at 165, 200, 207-210).

⁹⁸ One of the *Georgia Pacific* factors, is the "rates paid by the licenses for the use of other patents comparable to the patent in suit." 318 F. Supp. at 1120. While the Court does not suggest that the DSPG technology is necessarily comparable, it does offer a glimpse at standard contract terms of Marvell and the industry in general. This exhibit was admitted in connection with Dr. Armstrong's testimony, in part, to show that Marvell has entered into running royalty arrangements in the past. (Docket No. 682 at 252).

⁹⁹ CMU's DSSC licenses, equally, show that CMU licensed its patents on a worldwide basis, without reference to use in or outside the United States. (Def. Exs. 17; 39; 40).

¹⁰⁰ Mr. Hoffman stated "Nobody really knows is the bottom line. Okay? Because you just can't tell. You just -- you lose it. It goes through too many hands in commerce before I get a laptop here on my -- here in Pittsburgh or somebody else gets a laptop in Paris or Buenos Aires. It's -- you just don't know where those things are going." (Docket No. 710 at 361).

All relevant information on the estimate of chips used in the United States and the total number of chips produced worldwide was presented to the jury. Marvell argued to the jurors that they should consider only the number of chips that are ever used in the United States in valuing Marvell's use of the patented method, while CMU urged the jurors to consider all chips produced during the sales cycle regardless of whether they come back into the country. (Docket No. 759 at 96, 113). The factual record was such that the jury had substantial evidence on which to find in favor of CMU's theory.

The Court also believes that in envisioning a hypothetical negotiation, the jury could have properly considered as illogical an agreement to a per chip royalty predicated on an analytic neither party knows or tracks, and, depending on estimates, could vary by millions. It seems unrealistic that for one license agreement, Marvell and CMU would undergo extensive accounting review each and every year of import and export data of Marvell's customers (if even available). Moreover, such calculation would not include the number of simulators being used by Marvell. The Federal Circuit counsels that "where it is impossible to make a mathematical or approximate apportionment between infringing and noninfringing items, the infringer must bear the burden and the entire risk." *Nickson Indus., Inc. v. Rol Mfg. Co., Ltd.*, 847 F.2d 795, 799 (Fed. Cir. 1988); *see also TWM Mfg. Co., Inc. v. Dura Corp.*, 789 F.2d 895, 900 (Fed. Cir. 1986) (where infringer's failure to keep accurate records causes difficulty in ascertaining damages, infringer must bear adverse consequences).¹⁰¹

The Court also reminds counsel that CMU's damages request incorporates the damages for Marvell's indirect infringement, which if segregated from sales cycle infringement would have created an even larger award for CMU. The Court had to remind Marvell of this as one of

¹⁰¹ Under this precedent, any remittitur based on the location of end products would be based on Ms. Lawton's 556,812,092 million chip estimate. (Docket No. 710 at 165).

the verdict forms it proposed included separate lines for damages on each set of chips and simulators, which could have inadvertently led to an award far in excess of \$1.169 billion. (Docket No. 759 at 39).

b. Location of Sales

As previously discussed, CMU seeks damages based on the sales that are created because of Marvell's infringement during the sales cycle. Marvell argues for the first time in its reply brief on its Rule 50(b) Motion that CMU has not entered enough evidence to show that sales took place in the United States in light of the *Power Integrations* decision. (Docket No. 855 at 6).

First and foremost, Marvell seems to conflate several issues in maintaining that CMU must prove that the sales were made in the United States. Marvell's liability is not predicated on "sales," but rather on "use" under 35 U.S.C. § 271(a). Under CMU's theory, as proffered, it would seem that sales would not necessarily need to be made in the United States because as long as the sales were a direct result of Marvell's infringement in the United States during the United States sales cycle, the foreign sales would remain an appropriate component to value domestic infringement. Second, Marvell introduced no evidence at trial that any aspect of its sales took place outside the United States. Third, *Power Integrations'* damages theory was predicated on lost profits, while this matter focuses on finding a reasonable royalty or negotiated fee for the use of CMU's methods.

Next, there is the issue of waiver. Marvell contends that there is no evidence that sales took place in the United States, because there was no evidence of the location of delivery, location of the buyer, the passage of legal title, location of contracting, or execution of a sales contract. (Docket No. 855 at 6-8). It also argues that the jury was not instructed on the law relevant to determining the location of sales. (*Id.*). CMU objects to this argument because it was

never raised in either of Marvell’s two Rule 50(a) Motions during trial or even the initial post-trial Rule 50(b) Motion. (Docket No. 860).

A “defendant’s failure to raise an issue in a Rule 50(a)(2) motion with sufficient specificity to put the plaintiffs on notice waives the defendant’s right to raise the issue in [his] Rule 50(b) motion.” *State Farm Mut. Auto. Ins. Co. v. Lincow*, 444 F. App’x 617, 620 (3d Cir. 2011); *see also Lightning Lube, Inc. v. Witco Corp.*, 4 F.3d 1153, 1173 (3d Cir. 1993) (stating that Rule 50(b) motion “must be preceded by a Rule 50(a) motion *sufficiently specific* to afford the party against whom the motion is directed with an opportunity to cure possible defects in proof which otherwise might make [his] case legally insufficient”) (emphasis in original). Marvell did not raise this argument until its most recent *reply* brief. Throughout the trial, there was no argument on the sufficiency of showing, where legal title was passed or even argument on the sufficiency of the evidence regarding sales in general. This highlights why the Court of Appeals for the Third Circuit directs that such arguments must be raised in a sufficiently specific Rule 50(a) motion—if properly noticed, CMU could have submitted more evidence to rebut Marvell’s current assertions.¹⁰² Further, Marvell cannot argue that it only raised such argument because of *Power Integrations*, because the Court made it clear that the site of sales was not settled during discovery (Docket No. 195), at Summary Judgment (Docket No. 441), and in its order on the emergency motion on the fourth day of trial. (Docket No. 672).

To the extent that Marvell argues the jury should have been instructed on the legal definition of sales, including any of the aforementioned factors, that argument has been waived as such point for charge was neither suggested in proposed jury instructions nor preserved as an

¹⁰² For example, the Court notes that at summary judgment, CMU submitted the executed supply agreement between Western Digital and Marvell, signed in California, as an exhibit to rebut Marvell’s Motion for Summary Judgment of No Damage on Extraterritorial Conduct. (Docket No. 403 at Exhibit 68). However, in deciding a JMOL the Court relies only on the properly admitted evidence. *See Goodman*, 293 F.3d at 665 (3d Cir. 2002).

objection during the charge conference. (Docket Nos. 623; 761; 764). Indeed, the Court has reviewed the parties' proposed jury instructions, the numerous versions of draft final instructions, objections submitted via email and the transcript of the charge conference that spanned three days, and it can find no requests by Marvell for the Court to include such instructions. (*Id.*). The Court's instruction on contributory infringement required CMU to prove that Marvell "sold or offered to sell" infringing chips in the United States. (Docket No. 764 at 75). There was no request for an instruction defining sales in connection with this claim as well. If a party does not preserve its objection to the final instructions it cannot challenge them later. *Brooks v. City of Summit*, 138 F. App'x 390, 393 (3d Cir. 2005). Verdicts based on faulty instructions are only reversed where there is error that is "fundamental and highly prejudicial or if the instructions are such that the jury is without adequate guidance on a fundamental question and ... failure to consider the error would result in a miscarriage of justice." *Id.*

Even if Marvell has not waived this argument, which the Court believes it has, there is more than sufficient evidence for a jury to find that the sales occurred in the United States. First, in an effort to prevent CMU from entering numerous of Marvell's SEC filings into evidence, the parties stipulated that:

Eight, the headquarters and principal place of business of Marvell Semiconductor, Inc., also known as MSI, is located at 5488 Marvell Lane, Santa Clara, California.

Nine, the management and strategic decision-making of MSI as well as most of its business activities are conducted at MSI Headquarters in Santa Clara, California.

....

Fourteen, almost all of the design and development documents from MSI's read channel R&D organization are located in Santa Clara, California.

Fifteen, almost all of MSI's sales and marketing management personnel for read channel products are located in Santa Clara, California. MSI's sales and marketing decision-

making for read channel products is conducted in Santa Clara, California.

Sixteen, Alan Armstrong, vice-president of marketing, storage business group, and Bill Brennan, former vice-president of sales, storage business group, are knowledgeable about MSI's sales and marketing of the accused read channel products. Both of them work or worked in northern California, and the managerial functions that they carried out on a daily basis are essential to MSI's ongoing sales and marketing on data storage products.

Seventeen, almost all of MSI's sales and marketing documents concerning the accused read channel products are located in Santa Clara, California.

(Docket No. 764 at 49-56). Secondly, Dr. Armstrong testified that Mr. Brennan, based in California, signed off on the sales. (Docket No. 761 at Ex. C at 213). Then, Dr. Bajorek gave uncontradicted testimony that Marvell's sales "essentially take place in the United States" and identified the domestic office of each of Marvell's major customers.¹⁰³ (Docket No. 678 at 72, 105-106). In deciding a discovery dispute as to the scope of relevant discovery, nearly three years ago, this Court wrote that some factors in determining sales in the context of 35 U.S.C. § 271 could include:

(1) the location of the contemplated future sale, (2) the location of delivery, (3) the location of performance, (4) the location of the buyer; (5) the location of the passage of legal title; (6) the location of contracting; (7) the location of the negotiation of the sales contract, and (8) the location of the execution of the sales contract

(Docket No. 195 at 3-4). While these factors are not exhaustive or necessarily determinative, with the above-described stipulation in evidence, along with one of Marvell's SEC filings (Pl. Ex. 198), testimony from Dr. Armstrong, and expert testimony from Dr. Bajorek, there is

¹⁰³ Dr. Bajorek testified:

Hitachi, San Jose. Samsung in San Jose. Toshiba in San Jose. And Western Digital in San Jose, in Lake Forest, which is Southern California. In Longmont and Fremont, several design centers by Seagate.

Q Have you personally been in these design centers, sir?

A Yes, I have.

(Docket No. 678 at 106).

sufficient direct and circumstantial evidence to support the proposition that sales resulting from Marvell's sales cycles were made in the United States. *See, e.g., Snyder v. Bazargani*, 241 F. App'x 20, 23 (3d Cir. 2007) (juries can rely on direct and circumstantial evidence).

Again, there is no contrary evidence in the record showing that any activity beyond the manufacture of the chips occurred anywhere outside the United States. Marvell allowed CMU to present all of the evidence about Marvell's business structure, organization and sales cycle. Marvell presented no evidence to suggest that sales occurred in any other country.¹⁰⁴ Counsel did not argue to the jury that sales occurred in any other location than the United States. (Docket No. 759 at 96) (at closings arguing only that some chips are not used in the United States). Based on the testimony and exhibits of record presented at trial, a finding that the chips were sold outside the United States would have been without any evidentiary support. By withholding all evidence on its operations and sales, Marvell undermined its ability to counter CMU's proposition that the sales, in fact, occurred in the United States.¹⁰⁵

Marvell asks the Court to follow Judge Gilstrap's decision in *Lake Cherokee v. Marvell Semiconductor, Inc.*, wherein Marvell's evidence of foreign sales of chips was excluded as a basis for damages.¹⁰⁶ (Docket No. 890). However, in that case, not only was the court analyzing what constitutes a "sale" under 35 U.S.C. § 271(a),¹⁰⁷ but it was presented with undisputed facts regarding Marvell's foreign activities. (*Id.*). Based on the record before him, Judge Gilstrap was

¹⁰⁴ The only evidence in the record of any foreign activity came from CMU's expert, Dr. Bajorek who testified that Marvell chips are made in a Taiwanese foundry. (Docket No. 678 at 105).

¹⁰⁵ The Court ruled that if Marvell introduced evidence at trial, such as tax invoices, to try and establish the location of sales, CMU may be able to use certain evidence pertaining to Marvell's tax strategy, tax payments, effective tax rates, or corporate structure to rebut said argument. (Docket No. 605). Possibly as a preventive measure, Marvell did not submit any evidence or elicit any testimony that the Court could find "opened this door."

¹⁰⁶ The Court notes that Defendant Marvell Technology Group Ltd, the parent company of Marvell Semiconductor, and Marvell's Asian subsidiary MAPL, were not party to the Texas lawsuit. (Docket No. 890).

¹⁰⁷ CMU does not argue liability for Marvell's sales or offers to sell under § 271(a). Rather, CMU's theory of liability is based on Marvell's use of the patented method. (Docket No. 860).

able to conclude that there was “no dispute that companies abroad submit purchase orders to MAPL in Singapore and that, pursuant to such purchase orders, certain accused products are manufactured abroad, delivered abroad, and never cross United States borders physically or by legal title” and that “no revenues enter the United States.” (Docket No. 890-1 at 4-5). This Court is in no place to make any similar conclusions. Not a single purchase order, nor delivery receipt, nor any revenue data was introduced by Marvell. No Marvell witness testified that activities such as sales, orders, deliveries, or accounting occurred overseas. Marvell’s strategy was “all or nothing” in this case. By choosing to allow CMU to present *all* of the evidence regarding Marvell and its business, Marvell was not able to control the message given to the jury, nor was it able to establish convincing contrasting arguments.

In finding Marvell liable for contributory damages, the jury necessarily had to find that Marvell sold or offered to sell the Accused Chips in the United States. Considering all the evidence of record, the Court finds that there was sufficient evidence to support this finding, and accordingly no JMOL, new trial, nor remittitur is warranted.

c. “But For” Standard

Marvell next contends that CMU has failed to meet its burden on damages under the “but for” standard because it cannot prove that the sales of the Accused Chips arose due only to Marvell’s infringement. (Docket No. 739 at 16; Docket No. 809 at 16). Marvell asserts that: (a) no reasonable jury could conclude that the claimed methods in the patents-in-suit were “must have” for Marvell’s customers; (b) CMU has no evidence that the claimed methods were “must have” for Western Digital; (c) that non-infringing components made Marvell successful in the storage hard drive business; (d) that incremental SNR gains are achieved with multiple non-infringing components; (e) that no reasonable jury could conclude that Marvell would have gone

out of business but for the claimed methods used in the read channel; and (f) the location of Marvell's sales cycle is irrelevant. (Docket No. 739 at 16-26). CMU counters that it has presented sufficient evidence at trial from which a reasonable jury could find that Marvell's use of the claimed methods in the patents-in-suit was the "but for" cause of Marvell's sales of the Accused Chips. (Docket No. 725 at 9).

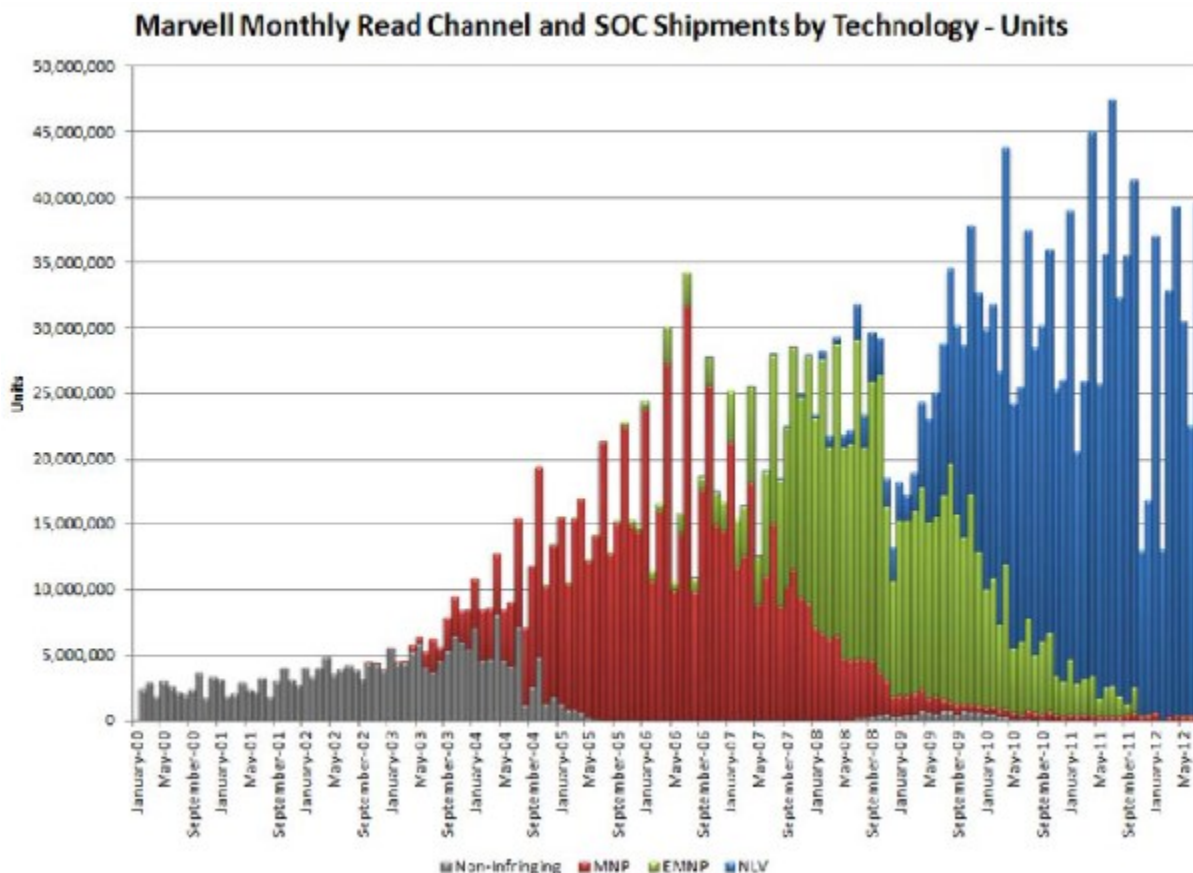
The Court finds that based on the evidence of record, viewed in the light most favorable to the non-movant CMU and drawing all inferences in its favor, a reasonable jury could determine that the alleged infringement in this case was the "but for" cause of the sales. Marvell has made a "mountain out of a molehill" in arguing the requirements of "but for" causation, maintaining that CMU must prove a certain level of customer demand or sole causation. (Docket No. 855 at 8). The Court ruled at the Summary Judgment stage that CMU's theory was reasonable given that Marvell's sales are the "but for" result of Marvell's infringement during the sales cycle. (Docket No. 441). The "but for" language on which Marvell relies does not arise from case law or statute in this instance, but from the parties' agreed-upon findings of fact. (Docket No. 402 at ¶ 8; Docket No. 415 at ¶ 8) ("Marvell would not make volume sales of the Accused Chips but for the use of Accused Chips in infringing modes in the U.S. during the sales cycle."). Thus, in stating in its summary judgment opinion that Marvell's sales were a "but for result of Marvell's infringement," the Court recognized that sales could be an indicator of the value of Marvell's use of the patents as long as there was a causal link between the infringement and the sales. (Docket Nos. 441; 672). The Court was not speaking to whether there could be only one cause or many. Regardless, the Court believes that CMU has met or exceeded its burden of proof as to same.

To this end, the parties’ stipulation that was read into the record at trial on December 11, 2012, and again as part of the final instructions, provides that Marvell’s lengthy (eighteen to thirty-month) sales cycle is a very important component of its business operations and is completed almost entirely within the United States by its engineers, marketing and sales executives as well as other members of Marvell’s staff at its Santa Clara offices. (Docket No. 676; Pl. Ex. 938). Nearly all of Marvell’s research and development, as well as its testing of chips and multiple interactions with customers, occur there. (*Id.*). If a customer selects Marvell to produce chips, Marvell achieves a “design win” whereby the customer orders a particular integrated circuit for a full generation of its product line. (Docket No. 707 at 29-34). As already recounted in addressing the JMOL motion on infringement, Dr. McLaughlin offered his expert opinions, which the jury was free to credit, that the simulators run by Marvell and the NLD and MNP-type chips sold by Marvell infringe CMU’s patents as Marvell uses the methods claimed in this case.¹⁰⁸ This opinion was bolstered by evidence adduced at trial that showed Marvell’s product simulators are operated during the sales cycle and that infringing engineering sample chips are used throughout the sales cycle. (Docket No. 707 at 45; Docket No. 678 at 70-162). It was also shown that all of Marvell’s products and sales are the result of this lengthy sales cycle and that “deals” are ultimately made by the Marvell sales team based in California. (Docket No. 761 at Jt. Ex C at 251-252). In addition, Dr. Bajorek gave his expert opinion, which the jury was able to accept, that all of Marvell’s sales of the NLD and MNP-type chips are the result of this United States sales cycle, and the MNP and NLD technology was the critical driver of the sale of these chips. (Docket No. 678 at 66-75).

The sales data upon which Ms. Lawton relied in her opinion showing the number of NLD and MNP-type chips sold by Marvell was provided by Marvell to CMU and not disputed at trial.

¹⁰⁸ See Docket No. 673 at 156-178; see also discussion *supra* at Section V.A.2.c.

(Docket Nos. 315; 686). She testified that between March 6, 2003 and July 28, 2012, Marvell sold 2,338,280,543 chips, (Docket No. 686 at 61), as illustrated by the following chart:



(Docket No. 868-16 at 6). A reasonable jury could conclude from this, and the other evidence of record, that Marvell’s use of the claimed methods in the United States was the “but for” cause of Marvell’s sales of the NLD and MNP-type chips.

The other matters that Marvell has raised, including whether the technology was “must have” for its customers like Western Digital, whether the other components in the NLD and MNP-type chip drove sales, the success of its other product lines at achieving SNR gains, and whether Marvell would have gone out of business without the use of the claimed methods, challenges the credibility and weight to be given to CMU’s damages evidence and presents factual issues the jury had to consider and decide. Marvell proclaims it is “undisputed” that

customers did not want the MNP. (Docket No. 885 at 9). The Court, however, does not agree. Marvell heavily relies on Iftiqar Baqai of Western Digital and Marvell’s Michael O’Dell to argue that customers did not want the MNP. Mr. Baqai testified that when he worked in the relevant division, Western Digital wanted to pull the MNP. (Docket No. 711 at 164). However, Mr. Baqai was only involved in read channel activities until 2005.¹⁰⁹ (*Id.* at 175). Moreover, Western Digital went on to buy one billion infringing chips with the technology enabled. (Docket No. 868 at Ex. 1; Pl. Ex. 1922). Mr. O’Dell, a late additional witness for Marvell, likewise stated that when he was with Marvell, customers wanted to remove the MNP; however, he did not work at Marvell in the critical time period between 2004 to 2010. (Docket No. 726 at 229).

On the other hand, CMU presented: (1) the expert testimony of Dr. Bajorek that the technology was “must have”; (2) internal Marvell communications showing failed predecessors to the MNP, requests to include the MNP as a “critical requirement,” as well as references that the MNP was a key feature in Marvell’s products; (3) testimony of Western Digital’s original corporate designee, Teik Ee Yeo, stating that Western Digital used the technology and saw gains from it; and (4) relevant data on Marvell’s sales of infringing products. (Docket No. 829 at 913). Even if the Court ignores all of the arguments by counsel, statements from witnesses, and opinions from experts, the data shows that a majority of all chips sold by Marvell contained the infringing technology. (Docket No. 686 at 117-126). Therefore, Marvell’s contentions of what is purportedly “undisputed” evidence do not hold weight. At most, the parties’ evidence created factual disputes for the jury, which were resolved in favor of CMU. *See, e.g., Curley v. Klem*, 499 F.3d 199, 208 (3d Cir. 2007) (factual disputes must be resolved by a jury). The Court finds

¹⁰⁹ Marvell avers that Mr. Baqai was present due to a subpoena. (Docket No. 711 at 144). CMU argued that Mr. Baqai, a California resident, was not technically compelled to appear by way of a subpoena from the Western District of Pennsylvania. *See* FED. R. CIV. P. 45(b)(2)(b). It is true that Mr. Baqai could not have been actually compelled by this subpoena, but he may have thought he was compelled to appear.

that there is sufficient evidence on which a jury could find that Marvell's infringement through the sales cycle was the cause of its sales.

d. Running Royalty

Marvell contends that CMU has adduced no evidence in support of a running royalty tied to product sales, allegedly undermining its damages case. (Docket Nos. 738; 805). As CMU points out in its response, there is sufficient evidence in the record from which the jury could have found the parties to the hypothetical negotiation determined that a running royalty was appropriate in this case. (Docket No. 725). As the Court held at the *Daubert* stage of these proceedings in the opinions addressing both the motion to exclude the testimony of Ms. Lawton and Mr. Hoffman, there is no established royalty for the patents-in-suit in this case. (Docket No. 449). To this end, as the Court recounted in one of the memorandum orders denying CMU's motions *in limine* to exclude the evidence of the Intel Subscription Agreement, (Def. Ex. 255), and the "Highly Speculative Forecast," (Def. Ex. 272), the parties to the hypothetical negotiation in this case would have to negotiate both the financial aspect of any license for the patents-in-suit as well as the framework or structure of the deal, including whether it was a running royalty or a lump sum payment. (Docket No. 609 at 5-6 (citing *Lucent Technologies, Inc. v. Gateway, Inc.*, 580 F.3d 1301, 1326 (Fed. Cir. 2009))).

In this Court's opinion, CMU presented sufficient evidence showing that both parties have used the running royalty structure in past license agreements. (Pl. Ex. 197; Def. Ex. 272). In the absence of an established royalty, a reasonable jury could conclude that the parties to the hypothetical negotiation would have agreed to a running royalty in accordance with Ms. Lawton's expert opinion.

As CMU recounts (Docket No. 725 at 7-8), the trial record contains evidence that Marvell has been a party to running royalty licenses in the past. Indeed, Dr. Armstrong has represented that Marvell entered into both lump sum and running royalty agreements in the past. (Docket No. 761 at Jt. Ex. C at 251-252). Ms. Lawton also relied on three license agreements for a running royalty into which Marvell had entered: (1) Hitachi; (2) DSP group (Pl. Ex. 197); and (3) ARM, during her testimony, to which there was no objection by Marvell. (Docket No. 710 at 112-113).

The trial record also contains evidence that CMU has been a party to both running royalty and lump sum licenses in the past. First, Ms. Lawton testified that she relied on a Showa Denko license agreement wherein CMU had agreed to a running royalty for a set number of cents per disk and Marvell did not object to such testimony. (Docket No. 710 at 112-113). Second, the “Highly Speculative Forecast” was entered in evidence over CMU’s objection. It contains a list of license agreements to which CMU has been a party and reflects that CMU was a party to running royalty agreements at that time.¹¹⁰ (Def. Ex. 272). Third, Dr. Wooldridge also testified that CMU had been a party to running royalty agreements in general and as set forth in the “Highly Speculative Forecast.” (Docket No. 682 at 102, 110).

For these reasons, the Court finds that CMU adduced sufficient evidence from which a reasonable jury could conclude that the parties to the hypothetical negotiation may have agreed to a running royalty in this case. Once again, the parties’ competing evidence on this issue was left for the jury to decide.

¹¹⁰ These include running royalties for ATRP with PPG, Ciba, Kaneka, and Dolonex; for Smartcube with Psychogenics; and for Microvelcro with Alza. (Def. Ex. 272).

e. Licensed Sales

Marvell’s final argument in its initial Rule 50(a) motion was that CMU improperly included licensed sales to non-party Seagate Technologies in the royalty base, relying on this Court’s Summary Judgment opinion dated August 24, 2012. (Docket No. 441). However, Marvell misconstrues the Court’s earlier decision. At that point in the litigation, the Court also found that Marvell’s use of the claimed methods during its sales cycle could support a verdict against it because there was no evidence of record that Seagate had exercised its “have made” rights under the license and solicited Marvell to build the patented technology for it.¹¹¹ (Docket No. 441 at 10-11). Without such evidence, the Court further found that Marvell’s use of the patented methods in this manner could support a claim for damages.¹¹² (Docket No. 441 at 12-14). As before, Marvell did not introduce any evidence at trial demonstrating that Seagate exercised its “have made” rights under its DSSC license such that the Court’s prior decision no longer stands. Nor have they convinced this Court that its prior decision was incorrect.

¹¹¹ Seagate, as a member of the DSSC, has a right to the patents-in-suit under the Associates Agreement. To this end, that agreement gives Seagate a right to have the Inventions made, i.e., “have made” rights. (Def. Exs. 39; 1003; 1008). However, it is not clear to the Court that the appropriate Seagate Associates Agreement covering these patents was entered into evidence, as at trial, Marvell only proffered unsigned copies of Seagate DSSC Associates Agreements. (Def. Exs. 39; 1003; 1008). These three versions of the agreement have conflicting terms for the period of 1992-1997. *Id.* The agreement in place in 1995-1997 would be controlling regarding Seagate’s “have made” rights for the patents-in-suit. Thus at trial, Marvell did not present uncontroverted evidence that Seagate had a license to the patents. Regardless, Marvell likewise did not proffer any contract, communication, testimony or document showing Seagate exercised any DSSC rights in conjunction with its dealings with Marvell.

¹¹² The Court’s reasoning was that had Seagate exercised its “have made” rights before Marvell undertook the sales cycle, it would not be liable for infringement. (Docket No. 411). If Marvell, however, did not secure such a grant of rights it would have infringed the patents in order to make a non-infringing sale. (*Id.*). Hence, the sales to Seagate could still demonstrate the value to Marvell of infringing CMU’s patents. (*Id.*).

4. Challenges to the Royalty Rate

a. Challenges to Ms. Lawton's Methodology

Marvell contends that a royalty of \$0.50 per chip is unsupported by the record because Ms. Lawton's opinion is speculative. (Docket No. 809 at 10-17). Marvell's first line of attack is on Ms. Lawton's use of excess profits analysis and operating profit premium analysis.

Because of Marvell's numerous challenges to Ms. Lawton, the Court held two *Daubert* hearings regarding Ms. Lawton's opinion at Marvell's request. (Docket Nos. 438-440; 706). In addressing these same arguments, the Court has now written over forty pages analyzing Ms. Lawton's qualifications and methods, ultimately holding that she was qualified to testify as an expert in this case and that she applied a reliable methodology in reaching her damages opinion. (Docket Nos. 451; 713). The Court incorporates both opinions herein and denies the Motion for Judgment as a Matter of Law, the Motion for a New Trial, and Motion for Remittitur to the extent that Marvell argues Ms. Lawton is not qualified to render her damages opinion, that her opinions were unreliable, or that they did not fit this case.

Going through these *Daubert* challenges, the Court put Ms. Lawton to the test, requiring her to first give her testimony *in camera* for all counsel and the Court before addressing the jury. Additionally, ten minutes before her testimony, the Court excluded Ms. Lawton's prepared slides, given numerous and time consuming arguments over them and what the Court determined to be a summary presentation that should not be permitted in a trial. (Docket No. 686 at 29).¹¹³

¹¹³ Despite these last minute changes and extra scrutiny, Ms. Lawton, in this Court's estimation, was remarkable as a witness. In the Court's thirty years of private trial practice and over six years on the bench, there have not been many witnesses (fact or expert) who have had such a grasp on all the facts and figures of a case, possessed the ability to answer thoroughly, succinctly, and convincingly, as well as communicate in a direct yet amicable manner.

With respect to her computations,¹¹⁴ Ms. Lawton initially arrived at a price-per-chip of \$4.42 and operating profit-per-chip of \$2.16 based on Marvell's internal sales data. (Docket No. 686 at 53-54). She then relied on comments from Marvell's CEO, Dr. Sutardja, and deposition testimony of Marvell's marketing executive, Dr. Armstrong, both of which suggest that Marvell's target gross margin for all of its products was 50%. (Docket No. 710 at 232-233). She next looked at Marvell's gross margin, operating income and excess profits from 2000 to 2013 of MNP and NLD chips and found that Marvell made approximately 59.6% profit on its gross margins. (*Id.* at 82-86; Lawton Chart 27). Based on this analysis, Ms. Lawton concluded that Marvell received \$0.42 of "excess profits" from its sales of the read channel and SOC chips, i.e., profit in excess of the 50% target margin. (*Id.* at 85-86). She then conducted an operating profit premium analysis in which she compared the sales of Marvell's chips to certain customers (Maxtor and Toshiba) for which she had information from the same time period (2003) where products were sold with and without the addition of the allegedly infringing MNP detector.¹¹⁵ (*Id.* at 95-100). From this data, Ms. Lawton calculated that Marvell had an operating profit delta¹¹⁶ between \$0.06 and \$0.72 on the chips containing the MNP/NLD compared to those that did not have an MNP/NLD. (*Id.*). She refers to this \$0.06 to \$0.72 range as the "operating profit premium" and suggests that this range would also have been the range of negotiations between

¹¹⁴ The full data and her calculations are detailed in her expert report which is over 500 pages with 3,000 footnotes. (Docket No. 356-1).

¹¹⁵ Marvell maintained that this comparison was not appropriate and cross-examined Ms. Lawton on same. (Docket No. 710 at 242-245). Ms. Lawton stated she compared these customers' chips because Dr. Armstrong advised that to analyze prices with respect to the chips that Marvell was selling, one would need to establish comparability of the chips. (*Id.* at 95-96). In order to establish comparability, she stated the chips would have to have: the same data rate; the same packaging; been sold to the same customer; and been sold in the same quarter. (*Id.*). Ms. Lawton also looked at the price deltas of Fujitsu, Hitachi, and Seagate, but stated they did not meet her comparability standard given that for Fujitsu the sales were not in the same quarter and for Hitachi the comparison chips had different data rates. (*Id.*). The prices for Seagate were listed in a price quote and Ms. Lawton stated she was not able to see the prices actually paid. (*Id.*).

¹¹⁶ An operating profit delta is the price delta minus the cost associated with the MNP. (Docket No. 710 at 97).

the parties during the hypothetical negotiation. *Id.* at 172. Ultimately, relying in part on her calculations of the excess profits benchmark of \$0.42 per unit, and the operating profit premium benchmark of \$0.06 to \$0.72 per unit, and considering all the other factors as laid out in *Georgia-Pacific*,¹¹⁷ Ms. Lawton opined that a reasonable royalty in this case was \$0.50. (Docket No. 710 at 170-171). After applying this figure to the 2,338,280,543 Accused Chips sold over the past ten years since March 6, 2003, she concluded that CMU's damages were \$1.169 billion. (Docket No. 686 at 61).

This analysis and testimony was in stark contrast to Marvell's damages expert, who did not do any financial analysis of Marvell's sales data. He only opined that CMU and Marvell would have agreed to a one time lump sum payment of \$250,000. (Docket No. 709 at 242-245). His opinion was based on the DSSC licenses and CMU-Intel Subscription Agreement. (Docket No. 709, 710). While he tried to discredit Ms. Lawton's in-depth analysis, he did not offer any analysis of his own of any sales data. Unlike Ms. Lawton, Mr. Hoffman appeared unfocused at times and repeatedly lost track of his points during his brief "expert" testimony. His expert opinion bordered on mere regurgitation of the facts related to the DSSC and Intel licenses, rather than any analysis based on his knowledge, education or expertise. His ultimate opinion was \$250,000 one-time lump sum, despite the fact that the Intel agreement was for a lump sum of \$200,000 and the DSSC agreement required annual \$250,000 payments. (Def. Exs. 17; 39; 40; 255). In the Court's estimation, it is not hard to see why the jury chose to credit Ms. Lawton over Mr. Hoffman. To that end, the jurors took their task in analyzing the expert opinions very seriously. Indeed, they asked the Court during deliberations if they could be provided with the

¹¹⁷ The factors she considered include: the advantages of the patented invention; the market and industry background; the date of the hypothetical negotiation; acceptable available non-infringing alternatives; consideration of the parties to the negotiation; projection sales; norms in the relevant industry; the structure of the agreement; royalties received by CMU; rates paid by Marvell; the commercial relationship between the two; the duration of the patents; and the use of the patents by Marvell, among many others. (Docket No. 761 at P. Demo 12).

full expert reports and demonstratives for both Ms. Lawton and Mr. Hoffman. (Docket No. 761 at Ct . Ex. 3).¹¹⁸

As the Court held at the summary judgment stage, whether Ms. Lawton’s testimony would be accepted or not is a “[d]eterminations regarding the weight to be accorded, and the sufficiency of, the evidence relied upon by the proffered expert...within the sole province of the jury.” (Docket No. 451 at 10) (citing *Walker v. Gordon*, 46 F. App’x 691, 695 (3d Cir. 2002)). The Court does not find any of the data points utilized by Ms. Lawton improper. Thus, the JMOL is denied to this extent, and a new trial and/or a remittitur is not warranted on this basis.

b. Damages Are “Out of Proportion”

Marvell next argues in its motion for JMOL that “CMU’s claim for \$1.169 billion is wildly out of proportion to its own pre-litigation assessments of value.” (Docket No. 739 at 12). It maintains that judgment as a matter of law is warranted as a result of Ms. Lawton’s failure to rely on the following evidence: (1) the DSSC membership licenses (Def. Exs. 17; 39; 40); (2) the August 5, 2003 letters to which Wooldridge testified that no company expressed any interest in taking a license (Pl. Exs. 422; 431; Def. Exs. 225; 235; 1573); (3) the 2004 Intel Subscription Agreement through which an offer was made to Intel for the patents-in-suit for a lump sum of \$200,000 (Def. Ex. 255); (4) the evidence that CMU had not entered into a single license arising out of engineering or computer science let alone a single, upfront licensing fee greater than \$100,000; and (5) the “highly speculative” projection spreadsheet and emails wherein Wooldridge stated that an estimate for the patents-in-suit was \$2,000,000.00 per year. (Def. Ex. 299).

As the Court noted in the Memorandum Order denying CMU’s Motion to Strike Mr. Hoffman’s testimony filed on December 18, 2012, all of this evidence underpins Mr. Hoffman’s

¹¹⁸ After consulting with counsel and hearing argument on same, the Court instructed the jury that neither the slide presentation nor any expert reports were admitted into evidence and could not be used in their deliberations. (Docket No. 765 at 12-13).

opinion that the reasonable royalty in this case would be a one-time, lump-sum payment by Marvell to CMU of \$250,000.00. (Docket No. 733). As the Court has recounted, Mr. Hoffman relied heavily upon this figure in both his expert report and opinion testimony.

Based on this Court's review of the record, Ms. Lawton did not disregard any of this evidence. She convincingly explained her consideration of the DSSC and Intel agreements and how those agreements affected her opinion. (Docket No. 686 at 138-166).¹¹⁹ Ms. Lawton identified the special nature of the agreements as well as the other forms of compensation the University received in connection with said agreements, such as research grants, funding, scholarships, sponsored fellowships, etc. (*Id.*). She did the same with respect to CMU's marketing efforts, discussing how this evidence did or did not affect her calculation of the reasonable royalty through her use of the hypothetical negotiation framework.¹²⁰ (*Id.*). The

¹¹⁹ On the DSSC agreements, Ms. Lawton testified:

Q: Did you consider these DSSC agreements and the fact that they provided for a 250,000-dollar annual fee?

A: Yes, I did.

Q: And did you have a view as to whether that was an appropriate measure of the -- of a royalty in this case?

A: Yes, I did.

Q: And what was your conclusion?

A: My conclusion is that that is not an appropriate measure in this case, because those were special agreements.

(Docket No. 686 at 138). In regards to the Intel agreement she testified:

Q: Okay. Now, we saw testimony in this case yesterday, at some length, about a subscription agreement between CMU and Intel. Do you recall the date of that subscription agreement?

A: September of 2004.

Q: And how does that compare to the date of the hypothetical negotiation?

A: That's about three-and-a-half years after the date of the hypothetical negotiation.

Q: And did you consider the existence of this Intel agreement in connection with your analysis?

A: I did, yes...

(*Id.* at 165-166).

¹²⁰ In considering the "highly speculative" spreadsheet Ms. Lawton noted:

record clearly shows she was cross-examined extensively by Marvell's counsel on these very points. (Docket No. 710 at 179-191). Obviously, Marvell disagrees with Ms. Lawton's opinions regarding the importance of this evidence, but that does not mean such facts were not considered.

The jury was presented with all of the evidence that Marvell avers was not considered by Ms. Lawton. Further, CMU's witnesses including Dr. Kavcic, Dr. Kryder, and Mr. Wooldridge were cross-examined on these facts. (Docket Nos. 673; 674; 682). Accordingly, the weight of these facts that underlie the experts' opinions was for the jury to decide. *See Micro Chem., Inc. v. Lextron, Inc.*, 317 F.3d 1387, 1394 (Fed. Cir. 2003). Whether Ms. Lawton's testimony would be accepted or not is a "[d]etermination[] regarding the weight to be accorded, and the sufficiency of, the evidence relied upon by the proffered expert...within the sole province of the jury." *Walker v. Gordon*, 46 F. App'x 691, 695 (3d Cir. 2002). As such, Marvell's motions for judgment as a matter of law are denied to the extent that it argues that the damages which were sought are "out of proportion" with reality.

c. Patented and Unpatented Features

Marvell claims that: (1) CMU has no evidence that the claimed algorithm drives customer demand; (2) CMU did not apportion the value of the claimed algorithm to the accused MNP chips; (3) the calculated price premium for one of Marvell's smallest customers is

Q: And we spent some time talking about what we at least fondly call the highly speculative memo at CMU that Mr. Wooldridge talked about yesterday. What -- how does the date of that -- do you know what the date of that memo was?

A: January of 2006.

Q: And how does the date of that memo compare to the date of the hypothetical negotiation?

A: Almost five years later -- four -- four years and ten months later.

Q: And how do all those dates compare to the dates of the events that you studied at Marvell?

A: They're well after the dates that surround the hypothetical negotiation on March 13th of 2001.

(Docket No. 686 at 166).

inapplicable to all accused sales;¹²¹ and (4) CMU's excess profits analysis is completely divorced from any measure of value for the claimed algorithm. (Docket No. 739 at 27-36). The Court finds that these arguments go to the weight rather than the admissibility of Ms. Lawton's testimony. *See Micro Chem., Inc. v. Lextron, Inc.*, 317 F.3d 1387, 1394 (Fed. Cir. 2003). She addressed each and every one of these arguments and was cross-examined by Marvell on same. (Docket No. 710 at 173-266). The Court has already reviewed her testimony at length here and in its opinion on Marvell's Motion to Exclude Catherine Lawton's testimony.¹²²

Similarly, the Court has already discussed the propriety of Ms. Lawton's price premium and excess profits analysis. Again, she based her reasonable royalty opinion on the opinion of Dr. Bajorek that the technology became "industry standard" and was "must have" for Marvell's survival and his other opinions regarding the value of the Accused Technology to Marvell's customers in order to establish liability. (Docket No. 686 at 68); *see, e.g., Member Services, Inc. v. Sec. Mut. Life Ins. Co. of New York*, Civ No. 06-1164, 2010 WL 3907489, at *27 (N.D.N.Y. Sept. 30, 2010) (an "expert may rely upon another expert to form an opinion under Rule 703" as long as the expert does not "merely recite another expert's opinion as his own"). Ms. Lawton also relied on Dr. McLaughlin's opinions on the infringement of the claimed algorithm on the MNP and NLD chips again in order to assume liability. *See, e.g., Sys. Dev. Integration, LLC v. Computer Scis. Corp.*, 886 F. Supp. 2d 873, 882 (N.D. Ill. 2012) ("It is entirely appropriate for a damages expert to assume liability for the purposes of his or her opinion. To hold otherwise would be illogical."); *Sancom v. Quest Commc'ns Corp.*, 683 F. Supp. 2d 1043, 1068 (D.S.D.

¹²¹ At trial and post-trial hearings, Marvell's counsel claims it was able to show that the average margin of non-infringing storage products is higher than its margin of infringing products. (Docket No. 880 at 65-66). However, Ms. Lawton explained that those non-infringing products include a non-read channel chip for Seagate that sells at a premium, and a chip that Marvell indicated had an MNP but CMU could not absolutely confirm this and out of an abundance of caution, she did not include this chip in its list of Accused Products. (Docket No. 710 at 257-258).

¹²² *See supra* at Section V.D.4.a.; *see also* (Docket No. 713).

2010) (“it is well-settled that a damages expert ... can testify as to damages while assuming the underlying liability”). The specific challenges to the factual underpinnings of these expert opinions go to the weight to be afforded to their respective testimonies. *See Miller*, 2011 WL 7037127, at *3 n.3.

The Court is guided by the Federal Circuit’s decision in *Micro Chemical, Inc.*, which aptly stated:

[t]his case is a classic example of competing experts. Each side had the opportunity to present its damages theory. Each party’s expert supported his reasonable royalty determination with an analysis of relevant factors based on his client’s view of the disputed facts. The outcome of the case depended to a large extent upon which predicate facts the jury believed, and then on which expert’s analysis they believed. Upon reviewing the record, we cannot say that [plaintiff’s] damages theory and the jury’s ultimate damages award were unsupported by substantial evidence. The defendants may not like the jury verdict, but it was the result of a fair trial, fairly fought.

317 F.3d at 1394. Likewise in this case, all of the evidence Marvell cites, along with their expert testimony, as well as their arguments, were presented to the jury, who had ample opportunity to consider same in their calculation of damages. Ms. Lawton’s opinion is not rendered unreliable simply because she reached a conclusion adverse to Marvell’s arguments on the facts. The jury was tasked with evaluating the credibility of all of the witnesses and the weight of the evidence in order to reach its ultimate decision on damages. They did just that and found for CMU. Accordingly, Marvell’s motion is denied on these grounds.

5. Conclusion on Damages

Marvell is in its current predicament because it deliberately undertook a series of strategic risks. It took the risk of incorporating technology into its products that it knew might have been covered by CMU’s Patents. It took the risk of continuing its use of this technology even after this litigation was initiated. It bore the risk of failing to keep or to demonstrate it kept

records pertaining to sales and use of its chips.¹²³ Its trial team took the risk of taking this case to trial, despite repeated efforts to mediate this case (Docket No. 236),¹²⁴ and knowing full well the size of the possible award. Indeed, Marvell has known CMU's position on damages since January 2012, when Catherine Lawton's expert report was produced. (Docket No. 315). Now, Marvell looks to the courts to relieve it from the damages award it faces from taking those risks. This Court, however, remains unconvinced by Marvell's arguments. Perhaps, in foreseeing such a result, Marvell has vowed to march forward on the chance that the Federal Circuit may favor its position, as Marvell has made it clear that it believes the Court's rulings were in error and against the great weight of Federal Circuit precedent. While Marvell may believe the Court's purportedly flawed legal analysis precipitated its defeat, it is the undersigned's impression as a Judge and former trial lawyer that Marvell's bad facts and even worse litigation strategy were fatal to its cause.

Marvell's strategy was always "all or nothing." At trial, Marvell argued that the parties would have agreed to a one-time payment of \$250,000. It took the risk that the jury would reject this argument.¹²⁵ In making this argument, Marvell intentionally declined to present evidence of a lower running royalty amount, upon which a jury could have awarded CMU substantially reduced damages. Marvell did not offer any evidence about its sales cycle, business strategy, technology, pricing or products, in relation to determining damages. It took the risk of not

¹²³ See discussion *supra* at Section V.D.3.b.

¹²⁴ Magistrate Judge Infante attempted to mediate this case twice, (Docket Nos. 236; 315), the Court held a settlement conference immediately before trial, (Docket No. 641), and the Court ordered the parties to Court-annexed mediation twice, once during trial, before the verdict and once before the hearing on post-trial motions. (Docket Nos. 734; 872). Despite same, this case is obviously still ongoing.

¹²⁵ It likely would have been difficult for the jury to believe the technology at issue was only worth a one-time payment of \$250,000 once they observed the number of lawyers in the Courtroom at any given time during this trial. Just the sight of these armies of attorneys would suggest to any casual observer that this case was about valuable technology and important for both sides.

presenting this evidence in order to keep its technology, products, and sales information secret. This was Marvell's choice. It should thus not come as a shock that the jury did not find in its favor, as it proffered no solid evidence about its business and its products.

CMU's damages expert Ms. Lawton was the only person in the trial to present evidence concerning Marvell's sales of the Accused Technology.¹²⁶ (Docket Nos. 868; 710). She was thus able to define Marvell's sales, characterize its actions in her favor, and support CMU's theory of the case. Opposing her was Mr. Hoffman, whose testimony appeared disjointed and did not demonstrate a comparably firm grasp of the facts and data as Ms. Lawton. Although he was dismissive of Ms. Lawton's opinion, he did not provide any other contrary calculations or well-considered alternatives. In effect, Marvell let CMU create a one-sided expert exposition, because it did not argue for any per chip royalty. This left the jury in a tough spot, with no reasonable options for a damages award other than \$250,000 or \$1.169 billion.¹²⁷ While the Court cannot even begin to calculate the hours it spent on arguments, objections at over 130 sidebars, and motions regarding minutiae,¹²⁸ Marvell's proper focus should have been on persuading the jury, if liability were found, that a lower royalty existed.¹²⁹

¹²⁶ Ironically, when Marvell wished to seal Ms. Lawton's trial slides months later, CFO Brad Feller provided an affidavit as to the importance of this information. (Docket No. 773).

¹²⁷ During deliberations on December 21, 2012, the jury requested a calculator. (Docket No. 761 at Ct. Ex. 2). Marvell objected to this request. (Docket No. 764 at 106-120, 131-132). As a result, the parties and the Court could not come to a resolution until the jury resumed deliberations on December 26, 2012. (Docket No. 765). The Court eventually advised the jury that a calculator could be made available upon request. (*Id.* at 13). The jury never again requested to use a calculator, and none was provided. In this Court's estimation, a calculator may have been in the best interest of Marvell because it could have allowed the jury to consider per chip royalties below \$0.50 per chip.

¹²⁸ See (Docket No. 72) (Marvell's Oral Motion to Strike Slide 19 of Plaintiff's Demonstrative); (Docket No. 660) ("Motion for Reconsideration Regarding Order Sustaining CMU's Objections to Disputed Defendants' Exhibit DX-189").

¹²⁹ Given the attitude of Marvell's counsel and its actions, the Court felt at times that Marvell was treating this trial as a dress rehearsal for the new trial that it hopes to gain from the Federal Circuit.

John Adams has observed that “[f]acts are stubborn things; and whatever may be our wishes, our inclinations, or the dictates of our passion, they cannot alter the state of facts and evidence.”¹³⁰ Such was the case for Marvell. CMU presented three extremely qualified and competent experts, each of whom did an excellent job explaining their opinions and pointing the jury to the factual proof underlying their opinions.¹³¹ On the other hand, Marvell focused on attacking CMU’s witnesses instead of presenting a cohesive defense based on its witnesses. While CMU had numerous fact witnesses, such as Dr. Cohon and Dr. Kryder, who apparently garnered credibility with the jury, Marvell’s employee testimony may not have been as convincing, especially when they had to struggle against facts tending to show infringement (naming the Accused Technology after Dr. Kavcic),¹³² and patent validity (email from the inventor of the Worstell patent). (Pl. Ex. 161).¹³³ Moreover, given the nature of the invention, everyone agreed that Dr. Kavcic’s method is the optimal solution. (Docket No. 677 at 170; 759 at 133). As Dr. Burd said in his displayed deposition testimony [Dr. Kavcic] “is kind of VIP which everybody tries to cite and everybody is citing, even in the papers... so it’s a natural thing

¹³⁰ John Adams, Argument in Defense of the Soldiers in the Boston Massacre Trials (December 1770), available at <http://www.bostonmassacre.net/trial/acct-adams3.htm>.

¹³¹ In contrast, at one point in trial, the Court observed two of out of Marvell’s three experts sound asleep for a period of time. In all likelihood, the jury made the same observation.

¹³² The Court particularly recalls the deposition testimony of Mr. Burd:

Q. And why use the Kavcic approach, as the yardstick?
 A. ...just because his name, kind of became a yardstick. I don’t know why. I mean, people use it. It’s like when you say-you know there are certain people which get associated with – some event....Ronald Reagan is credited with breaking down the wall. Well, I didn’t see him break any bricks. Right? But yet, he is the one. So same thing.

(Docket No. 771 at Ex. H at 110).

¹³³ Three former Marvell employees Mr. Doan, Dr. Armstrong, and Mr. Brennan did not appear in person, opting to testify by deposition designations, and offered testimony helpful to CMU’s cause. (Docket No. 761 at Jt. Exs. A, C, D). For example, Mr. Doan testified that he never looked at the patents, never directed others to look at them, and never contacted Marvell’s legal department about them. (Docket No. 761 Jt. Ex. D at 125, 130).

to compare yourself to, you know, people whose work considered to be, you know, on a leading edge or on the cutting edge of a field.” (Docket No. 771 at Ex. H at 110). While these facts may not be dispositive on the issues of infringement, invalidity, and willfulness, they were nevertheless very difficult to overcome.

As to damages, there is likewise telling sales data that shows that a majority of all chips sold by Marvell used the Accused Technology for a ten-year period. (Docket No. 686 at 117-126; P-Demo 13). Marvell’s revenue on the Accused Technology was \$10.34 billion, with a total operating profit of \$5.05 billion.¹³⁴ (Docket No. 868 at P Demo 9-Lawton Chart 4). Over the past decade, Marvell has grown to become the dominant market leader, holding 60% of the market. (Docket No. 707 at 122). If a new trial is warranted, Marvell will have to proceed to trial with these same facts and the same experts.¹³⁵ The Court is not sure how different the outcome would be.

While the Court acknowledges this award is large, the facts show that the infringement was long and sustained. Marvell often ridiculed CMU’s request for a billion dollars; however, just because a damages award is large¹³⁶ does not mean the Court’s standard of review changes.

¹³⁴ In an abundance of caution, the Court did not permit Ms. Lawton to discuss the total figures of revenue and profit, but only offer average revenue and profit per chip. However, it was within the jurors’ prerogative to “do the math,” as both the average values and the volume of chips (2.34 billion) were proffered.

¹³⁵ Expert discovery closed in this matter on April 16, 2012, and it will not be reopened if a new trial is ordered. (Docket No. 335). Thus, Marvell would be limited to Mr. Hoffman’s expert damages opinion of \$250,000 in any future proceedings.

¹³⁶ The size of the award is in part of Marvell’s own making. Since this matter was filed in March 2009, Marvell has not made any efforts to remove the Accused Technology from its products and sold a number of infringing products, thereby incurring a substantial amount of additional damages of around \$535 million based on information regarding sales dating to July 29, 2012. (Docket No. 569; Docket No. 889-2 at 2). According to the latest joint submissions regarding sales data, Marvell has sold 363,752,585 infringing chips from July 29, 2012 to August 3, 2013, (Docket No. 889 at 3; Docket No. 898 at 2), thereby yielding \$181,876,292.50 in added damages. This combined sum of more than \$716 million in damages accrued (and likely attorney fees as well as costs approaching \$20 million) since the initiation of this litigation could have easily been avoided if the parties came to a reasonable and mutually beneficial licensing agreement or settlement agreement—such as the Marvell Hall of Engineering at CMU—back in 2009.

At this stage of the case, the Court is only an “umpire,”¹³⁷ checking to make sure there is sufficient evidence upon which a reasonable jury could have returned their verdict. *Galena*, 638 F.3d at 196. The nature and scope of the damages to be awarded was properly left to the jury.

For all of these reasons and after considering all of the evidence in this case, in the light most favorable to CMU, and drawing all reasonable inferences in its favor, the Court denies Marvell’s Motion for Judgment as a Matter of Law on Damages, its Motion for a New Trial, as well as its Motion for Remittitur.

VI. CONCLUSION

Given the above findings and analysis, the Court denied the parties’ motions for JMOL before giving the case to the jury for deliberations. (Docket Nos. 699; 701; 703; 731; 738; 740; 742; 747). For these and other reasons discussed herein, the Court denies Marvell’s Motion for Judgment as a Matter of Law, or in the Alternative, New Trial on Non-Damages Issues (Docket No. 805), and Marvell’s Motion for Judgment as a Matter of Law, New Trial And/Or Remittitur With Respect To Damages. (Docket No. 807). The Court grants CMU’s Motion for a Finding of Willful Infringement and Enhanced Damages (Docket No. 790), in part, on willfulness, and reserves its ruling on enhanced damages for a forthcoming opinion. The Court also reserves its rulings on Marvell’s Motion for Judgment on Laches, (Docket No. 802), CMU’s Motion for Permanent Injunction, Post-Judgment Royalties, and Supplemental Damages (Docket No. 786),

¹³⁷ As Chief Justice Roberts said in his opening statements before the Senate Judiciary Committee in 2005,

Judges and justices are servants of the law, not the other way around. Judges are like umpires. Umpires don’t make the rules; they apply them. The role of an umpire and a judge is critical. They make sure everybody plays by the rules. But it is a limited role. Nobody ever went to a ball game to see the umpire.

Confirmation Hearing on the Nomination of John G. Roberts, Jr. to be Chief Justice of the United States Before the S. Comm. on the Judiciary, 109TH CONG. 55 (2005).

and CMU's Motion for Prejudgment and Post-Judgment Interest (Docket No. 788), for a memorandum opinion that will be filed in due course.

s/Nora Barry Fischer
Nora Barry Fischer
United States District Judge

Date: September 23, 2013

cc/ecf: All counsel of record.